



February 4, 2008

TO: PARTIES INTERESTED IN ACCEPTANCE CRITERIA FOR WORK CAGES FOR WIND TURBINE TOWERS

SUBJECT: Proposed New Acceptance Criteria for Work Cages for Wind Turbine Towers, AC394-0208-R1 (RB)

Dear Madam or Sir:

A new acceptance criteria, as presented in the attached criteria draft, is being posted on the ICC-ES web site to allow public comment.

This proposed criteria addresses requirements for work cages installed in wind turbine towers. The cage transports workers up to maintenance locations, rather than using a ladder. The applicant provides the following reasons why the work cage should not be considered an elevator:

1. *The existing elevator code is written for public access systems inside buildings and general applications. Wind towers are not public access and are limited to a specialized crew of workers specifically trained for this type of work environment.*
2. *Elevators are designed to be attached to specific structural points inside a shaft. In some cases this may involve internal rails and structural connection points. This is not possible inside a wind tower because the tower is not designed to sustain additional connections due to the high degree of fatigue stress that exists inside these tower shells. Work cages accomplish this without interfering with the structural integrity of the Wind tower.*
3. *Wind towers are increasingly becoming a large sector of the power generation industry. The next 10 years will see a 200% increase in the existing usage of wind generated power. Work cages will be necessary for ongoing continued maintenance and access to service this industry. Therefore, it is important that this criteria should be instituted to facilitate a standardized and organized approach to this industrial application.*

Staff requests specific input on the following items:

1. The concept noted above, regarding applicability of elevator provisions.

2. Sections 3.4 and 5.3: What is the appropriate factor of safety for the steel cable? Should the load be based on dynamic forces induced by suddenly stopping the work cage at mid-height?
3. Section 3.7 indicates the work cage components must have documentation of a 10-year corrosion resistance. Which standard should be referenced?

You are cordially invited to submit written comments, within 30 days of the date of this letter. An explanation of the alternate criteria process can be found on our web site at http://www.icc-es.org/Criteria_Development/alternative_criteria_process.shtml.

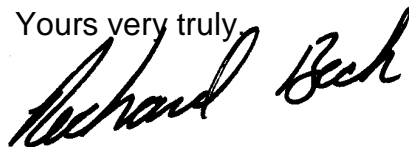
All comments received in the 30-day comment period will be considered in preparing a proposed criteria that may be considered at a future Evaluation Committee meeting. Comments received will be posted on the web site shortly after the close of the comment period.

Your cooperation is requested in forwarding to the Los Angeles business/regional office all material directed to the Evaluation Committee. Parties interested in the deliberations of the committee should refrain from communicating, whether in writing or verbally, with committee members. The committee reserves the right to refuse communications that do not comply with this request.

Newly approved acceptance criteria may involve test methods or test protocols that are not currently included in the scope of testing services offered by accredited testing laboratories. As noted in the ICC-ES Rules of Procedure for Evaluation Reports, the scope of the laboratory's accreditation must include the type of testing that is to be reported to ICC-ES. We encourage accredited laboratories to expand their scopes of accreditation to include testing under newly approved acceptance criteria. Please note that testing laboratories must be accredited by the International Accreditation Service (IAS) or by another accreditation body that is a signatory to the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement. For further information, please contact IAS at (562) 699-0541, extension 3309, or send an e-mail to pmccullen@iasonline.org.

If you have any questions, please contact the undersigned at (800) 423-6587, extension 5690. You may also reach us by e-mail at es@icc-es.org.

Yours very truly,



Richard Beck, PE, CBO, MCP
Principal Mechanical Engineer

RB/raf

Enclosures

cc: Evaluation Committee



PROPOSED ACCEPTANCE CRITERIA FOR WORK CAGES FOR WIND TURBINE TOWERS

AC394

Proposed February 2008

PREFACE

Evaluation reports issued by ICC Evaluation Service, Inc. (ICC-ES), are based upon performance features of the International family of codes and other widely adopted code families, including the Uniform Codes, the BOCA National Codes, and the SBCCI Standard Codes. Section 104.11 of the *International Building Code*[®] reads as follows:

The provisions of this code are not intended to prevent the installation of any materials or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.

Similar provisions are contained in the Uniform Codes, the National Codes, and the Standard Codes.

ICC-ES may consider alternate criteria, provided the report applicant submits valid data demonstrating that the alternate criteria are at least equivalent to the criteria proposed in this document, and otherwise meet the applicable performance requirements of the codes. Notwithstanding that a product, material, or type or method of construction meets the requirements of the criteria proposed in this document, or that it can be demonstrated that valid alternate criteria are equivalent to the criteria in this document and otherwise meet the applicable performance requirements of the codes, ICC-ES retains the right to refuse to issue or renew an evaluation report, if the product, material, or type or method of construction is such that either unusual care with its installation or use must be exercised for satisfactory performance, or malfunctioning is apt to cause unreasonable property damage or personal injury or sickness relative to the benefits to be achieved by the use of the product, material, or type or method of construction.

PROPOSED ACCEPTANCE CRITERIA FOR WORK CAGES FOR WIND TURBINE TOWERS

1 1.0 INTRODUCTION

2 1.1 **Purpose:** The purpose of this acceptance criteria is to establish
3 requirements for work cage lifts to be recognized in an ICC Evaluation Service, Inc.
4 (ICC-ES), evaluation report under the 2006 *International Building Code*[®] (IBC). The
5 basis of recognition is IBC Section 104.11

6 The reason for the development of this criteria is to establish guidelines for the
7 evaluation of steel cable assemblies, since the IBC and associated reference standards
8 do not specify qualification, design and quality requirements for these steel cable
9 assemblies.

10 1.2 **Scope:** This criteria applies to work cage assemblies intended to serve as
11 man and material lifts in a single steel tubular wind tower structure. The work cage
12 uses an electric motor connected to steel cabling to move vertically. This acceptance
13 criteria only addresses the performance assembly, quality control, and structural
14 requirements of work cages. Recognition under this criteria is for all Seismic Design
15 Categories. This product is only for worker access inside wind tower structures.

16 1.3 **Codes and Referenced Standards:**

17 1.3.1 2006 *International Building Code*[®] (IBC), International Code
18 Council, Inc.

19 1.3.2 ASCE/SEI 19-96, Structural Applications for Steel Cables for
20 Buildings, American Society of Civil Engineers/Structural Engineering Institute.

21 **1.4 Definitions:**

22 **1.4.1 Work Cage:** The work cage assemblies serve as permanent
23 access platforms that hoist workers and material to various levels inside the wind tower,
24 to perform maintenance and access throughout the tower. The work cage is not
25 designed for use in silos, on drilling sites, as a permanently installed facade lift, as a
26 crane lift, or in environments with explosion hazards. The work cage is fully enclosed.
27 The work cage is not considered an elevator.

28 **1.4.2 Cable:** A flexible tension member consisting of a wire strand or a
29 multiplicity of wire strands forming a wire rope.

30 **1.4.3 Cable Assembly:** An assembly fabricated from wire rope with a
31 swaged fitting on each end.

32 **1.4.4 External Tensile Force:** Tensile service force in cable assembly
33 imposed by external force.

34 **1.4.5 Corrosion Resistant Materials:** Materials that have corrosion
35 resistance against seawater exposure and proven durability to resist this exposure for a
36 minimum of ten years.

37 **1.4.6 Relaxation:** The loss of tensile force in a prestressed cable, over
38 a period of time, while the cable maintains a constant length.

39 **1.4.7 Residual Tension:** Tensile force in the cable assembly after
40 relaxation and shrinkage has occurred but before external tensile forces are imposed
41 on the assembly.

42 **1.4.8 Rope:** A plurality of strands twisted about an axis or about a core
43 which may be a strand or another wire rope.

44 **1.4.9 Work Cage Motor:** The primary motor device utilized to provide
45 tensioning in the cable for lifting the work cage (traction hoist).

46 **1.4.10 Wind Tower Structure:** The main structure that supports a
47 wind power generation system supported at any height.

48 **1.4.11 Strand:** A plurality of wires either parallel or helically twisted
49 about an axis, usually about a central wire.

50 **1.4.12 Work Cage Capacity:** The maximum number of workers
51 and weight permitted inside one work cage, referenced by a maximum lifting capacity.
52 All work cages under this criteria shall have a minimum lifting capacity of 500 pounds
53 (220 kg).

54 **2.0 BASIC INFORMATION**

55 **2.1 General:** The following information shall be submitted:

56 **2.1.1 Product Description:**

57 **2.1.1.1 Work Cage:** Complete information pertaining to the
58 work cage and assembly, including component descriptions, material specifications and
59 drawn-to-scale production drawings showing all dimensions and tolerances, and the
60 manufacturing process as well as the factor of safety for the cable assembly.

61 **2.1.1.2 Electrical Conductors:** A complete description,

62 including applicable standards, of electrical conductors along with any protective
63 coatings, shall be submitted.

64 **2.1.1.3 Lifting Capacity Description:** Lifting capacity shall
65 be completely described, including the maximum lifting capacity, nominal diameter and
66 maximum length of steel cables.

67 **2.1.1.4 Material Properties:** Physical properties, including
68 strength properties and description of compatibility with steel cable materials, shall be
69 submitted. Protective coatings and compliance of materials for a service life of ten
70 years shall be documented.

71 **2.1.2 Installation Instructions:** Complete dated manufacturer's
72 installation instructions shall be submitted. Such instructions shall include details of
73 structural connections to the tower.

74 **2.1.3 Packaging and Identification:** A description of the method of
75 packaging and field identification of the work cage. Identification provisions shall
76 include the evaluation report number and, if applicable, the name or logo of the
77 inspection agency.

78 **2.1.4 Field Preparation:** Complete instructions for field adjustments
79 shall be provided.

80 **2.2 Testing Laboratories:** Testing laboratories shall comply with Section 2.0
81 of the ICC-ES Acceptance Criteria for Test Reports (AC85) and Section 4.2 of the ICC-
82 ES Rules of Procedure for Evaluation Reports. The testing laboratory shall prepare

83 cable and end fitting assemblies, or verify that preparation of cable and end fitting
84 assemblies is in accordance with the cable assembly manufacturer's quality control
85 documentation.

86 **2.3 Test Reports:** Test reports shall comply with AC85.

87 **2.4 Product Sampling:** Sampling of the work cage for tests under this
88 criteria shall comply with Section 3.1 of AC85.

89 **3.0 TEST METHODS AND PERFORMANCE REQUIREMENTS**

90 **3.1 Physical Dimensions:** A recognized work cage shall be documented as
91 having a minimum height of 6 feet, minimum width of 3 feet, and minimum depth of 2
92 feet. The minimum lifting capacity shall be 500 pounds (220 kg).

93 **3.2 Work Cage Capacity:** A recognized work cage shall be documented as
94 having a maximum lifting capacity of 1,000 pounds.

95 **3.3 Floor Strength:** The work cage shall be tested and documented to
96 provide a minimum strength of 300 psf (1464 kg/m²) at the floor level while suspended.

97 **3.4 Cable:** The cable shall be documented as having a factor of safety of
98 ???, based on the loaded work cage abruptly stopping at midlevel.

99 **3.5 Motor Strength:** The motor shall be tested and documented to move the
100 work cage while loaded in accordance with Section 3.1.

101 **3.6 Manual Operation:** The work cage shall have a manual method for
102 raising or lowering itself which can be actuated from within the cage.

103 **3.7 Corrosion Resistance:** All components of the work cage and lift system

104 shall be documented according to ASTM ???? as having an ten-year corrosion
105 resistance.

106 **4.0 QUALITY CONTROL**

107 **4.1** The products shall be manufactured under an approved quality control
108 program with inspections by an inspection agency accredited by the International
109 Accreditation Service (IAS) or otherwise acceptable to ICC-ES.

110 **4.2** Quality documentation complying with the ICC-ES Acceptance Criteria for
111 Quality Documentation (AC10) shall be submitted.

112 **4.3** Work cages shall be operated under a quality assurance program and
113 safety plan to be maintained by the manufacturer and implemented through licensing
114 and examination of work cage users.

115 **4.4** Each manufacturer shall submit a quality assurance and quality control
116 (QA/QC) plan for the fabrication and maintenance of the work cage product. Along with
117 the QA/QC plan, the manufacturer shall provide a detailed safety manual and training
118 program for each work cage installation. The safety and training program shall be
119 implemented and maintained through specific local licensing of work cage users, and
120 the manufacturer shall keep records of all user licenses throughout the term of each
121 work cage.

122 **5.0 EVALUATION REPORT RECOGNITION**

123 **5.1** The evaluation report shall contain a condition of use requiring engineering
124 calculations for the design of the cable attachment points, which are sealed by a

- 125 registered design professional. The design of connections and anchorages,
126 including plates and hold-downs, as well as other components needed to transfer
127 the tension load between portions of the structure, shall be determined in
128 accordance with the applicable code for each project. Design loads shall be
129 determined by the person responsible for the structural design, and shall be
130 specified to accommodate the worst-case scenario for a particular wind tower.
- 131 **5.2** The evaluation report shall note that the electrical supply is beyond the scope of
132 evaluation.
- 133 **5.3** The work cage shall bear a display of the maximum load using a factor of safety
134 of ????
- 135 5.4 Use of the work cage assemblies is limited to wind tower structures only.
- 136 5.5 Use of the work cages is limited to construction/maintenance workers only, who
137 shall be certified and trained in use of the work cage by the work cage
138 manufacturer.
- 139 5.6 Unless data in accordance with Section 2.1.1.4 of this criteria is submitted, the
140 evaluation report shall state that installation must be limited to dry, interior
141 conditions.
- 142 5.7 Use of the work cage assemblies shall specify the wind tower height limitation
143 and minimum tower shell thickness.
- 144 5.8 Special inspection and structural observation shall comply with IBC Sections
145 1704 and 1709, respectively. ■