

## NEW WORK ITEM PROPOSAL (NP)

PROPOSER: <b>Denmark</b>	DATE OF PROPOSAL: <b>2022-03-01</b>
DATE OF CIRCULATION: <b>2022-03-11</b>	CLOSING DATE FOR VOTING: <b>2022-06-03</b>

## IEC TC 88: WIND ENERGY GENERATION SYSTEMS

SECRETARIAT: <b>Denmark</b>	SECRETARY: <b>Mrs Christine Weibøl Bertelsen</b>
NEED FOR IEC COORDINATION:	PROPOSED HORIZONTAL STANDARD <input type="checkbox"/> Other TC/SCs are requested to indicate their interest, if any, in this NP to the TC/SC secretary
FUNCTIONS CONCERNED: <input type="checkbox"/> EMC <input type="checkbox"/> ENVIRONMENT <input type="checkbox"/> QUALITY ASSURANCE <input type="checkbox"/> SAFETY	

## TITLE OF PROPOSAL:

**Wind energy generation systems – Part 21-5: Configuration, functional specification, and validation of hardware-in-the-loop test bench for wind power plants (proposed IEC TS 61400-21-5)**

☐ STANDARD ☒ TECHNICAL SPECIFICATION

PROPOSED PROJECT NUMBER: 61400-21-5

## SCOPE

(AS DEFINED IN ISO/IEC DIRECTIVES, PART 2, 14):

The proposed work for the NWIP "Specification of hardware-in-the-loop test bench for test of AC and DC connected wind power plants" is to define uniform specifications of control-hardware-in-the-loop test bench used for testing the integrity and interoperability of large wind power plants connecting with AC or DC grids, applicable both in offshore and onshore contexts.

The specifications of the testbench includes

1. Definition of the control replica of a wind turbine and a wind power plant including the configuration of the hardware sub-systems and specifications of the control and protection functions that are delivered by the control replica;
2. Requirements on the wind turbine and power plant control replica functionalities and performance;
3. Requirements of the data and communication interfaces of the control replica to interoperate with other control replicas such as HVDC for composite tests;
4. Requirements of the model of the main components (including validation procedure) of the wind farms and the external grid in the real time simulation environment;
5. Specifications of the signal interfaces between the control replica and the real time simulation environment, including the performance requirements on the measurement system, as well as the communication system including the use of communication protocols;

The work item will define the following procedures,

1. Test procedures for wind turbine control and protection functions
2. Test procedures for wind power plant control functions
3. Test procedures for wind power plant protection functions
4. Validation procedures of the dynamic performance of the testbench compared against field measurements;
5. Verification procedures for the transferability of the hardware-in-the-loop test results.

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#### PURPOSE AND JUSTIFICATION

INCLUDING THE MARKET RELEVANCE AND WHETHER IT IS PROPOSED TO BE A HORIZONTAL STANDARD.

MARKET RELEVANCE SHOULD BE ADDRESSED BY INDICATING THE NEED FOR THE CORRESPONDING STANDARDS WORK AND ITS GLOBAL RELEVANCE (SEE ISO/IEC DIRECTIVES, PART 1 ANNEX C)

IF PROPOSED AS A HORIZONTAL STANDARD, IDENTIFY AS POSSIBLE, THE CORRESPONDING APPLICABLE GUIDE(S) AND ASSOCIATED ADVISORY COMMITTEE(S) (SEE GUIDE 108).

#### Background:

Design and verification of Wind Turbine Generator (WTG) and Wind Power Plant (WPP) for its interoperability with the electrical power systems is becoming crucial, given the increasing size of WPPs being designed and constructed and the ever decreasing short circuit power of the electric power systems. This raises the urgency of new test practice and requirements for WPP, including design integrity of itself and grid codes compliance, as well as performance verification during commissioning as well as in the maintenance period after being updates of software, firmware, and controls.

Forthcoming technologies like floating wind turbines for deep waters will push the new offshore wind farms farther away from the shore where connections through HVDC is on the agenda. For interoperability of wind farms with HVDC, it is essential to establish a reliable approach for connectivity of wind farms with other systems other than the electric power networks.

The above trend asks for transparency of the functional characteristics of WTG and WPP including its subsystems with the electric network operators, wind farm operators, and HVDC manufacturers over the lifecycle.

#### Purpose:

As WPPs (especially for offshore) have reached GW size, and the connection of WPP to the system is becoming more complex in terms of the technologies and distance to shore, the design and compliance tests of the WPPs is more technical demanding, expensive, but crucial for the safe and economic operation of WPPs. The purpose of the technical specification is to describe test bench requirements based on hardware-in-the-loop (HiL) method, including the validation and verification procedures thereby move inflexible field tests of WPPs to a configuration and controllable testbench setup.

The technical specification will specify the WT and WPP control replica design, functional capabilities to perform the essential tests of the capabilities of WT and WPP through HiL, thereby verify the design integrity of the wind farm as well as support the compliance and interoperability of WTG and WPP.

The TS will specify the testbench including the components of the control replica, measurement and communication interfaces between real time simulation environment and the WTG and WPP control replica and other systems such as HVDC under test, so that tests can be enabled and implemented on testbench level for verification of WPP during commissioning and maintenance phases.

The work will serve as basis to ensure design integrity and interoperability test of wind power plants during commissioning and maintenance phases. The work item will support the following use cases for wind power plants including but not limited to

1. Grid codes compliance of wind turbine generators;
2. Reliability and security of the protection system of the wind farm;
3. Interoperability between wind farm and HVDC;
4. Functionality and performance test of Plant control;
5. Control coordination within the power plant and between the plant and the external;
6. Evaluate and compensation of the wind farm against resonance with other systems;
7. Validation of the offline EMT models of the wind turbines and the aggregated wind farm;
8. Stability of the connection between the wind farm and the external grid;

The proposed working item has the following relations with the existing projects

1. The work item serves a continuation of 61400-21-4 on subsystem level testing via extending the scope to plant level focus;
2. The results of the tests from the test-bench can be used as input for the verification of requirements as described in the IEC61400-21 series (-1 at WTG level, -2 at WPP level);
3. The measurements and simulation results taken from the testbench described here can be used as input to 61400-27 series on validation of the models.

PLEASE SELECT ANY UN SUSTAINABLE DEVELOPMENT GOALS (SDGs) THAT THIS DOCUMENT WILL SUPPORT. FOR MORE INFORMATION ON SDGs, PLEASE VISIT OUR WEBSITE AT [HTTPS://WWW.IEC.CH/SDG/](https://www.iec.ch/sdg/)

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|---|--|
| <input type="checkbox"/> GOAL 1: No Poverty   | <input type="checkbox"/> GOAL 10: Reduced Inequalities                   |
| <input type="checkbox"/> GOAL 2: Zero Hunger  | <input type="checkbox"/> GOAL 11: Sustainable Cities and Communities     |
| <input type="checkbox"/> GOAL 3: Good Health and Well-being                         | <input type="checkbox"/> GOAL 12: Responsible Consumption and Production |
| <input type="checkbox"/> GOAL 4: Quality Education                                  | <input checked="" type="checkbox"/> GOAL 13: Climate Action              |
| <input type="checkbox"/> GOAL 5: Gender Equality                                    | <input type="checkbox"/> GOAL 14: Life Below Water                       |
| <input type="checkbox"/> GOAL 6: Clean Water and Sanitation                         | <input type="checkbox"/> GOAL 15: Life on Land                           |
| <input checked="" type="checkbox"/> GOAL 7: Affordable and Clean Energy             | <input type="checkbox"/> GOAL 16: Peace, Justice and Strong Institutions |
| <input type="checkbox"/> GOAL 8: Decent Work and Economic Growth                    | <input type="checkbox"/> GOAL 17: Partnerships for the Goals             |
| <input checked="" type="checkbox"/> GOAL 9: Industry, Innovation and Infrastructure |  |

TARGET DATE(S)		FOR FIRST CD: 2023-07-31		FOR TS: 2024-12-31	
ESTIMATED NUMBER OF MEETINGS:	FREQUENCY OF MEETINGS:	DATE OF FIRST MEETING:	PLACE OF FIRST MEETING:		
12	4 per year	2022-06-23	Denmark		
RELEVANT DOCUMENTS TO BE CONSIDERED:					
IEC 61400-21 Series					
IEC 61400-27 Series					
RELATIONSHIP OF PROJECT TO ACTIVITIES OF OTHER INTERNATIONAL BODIES:					
Standards activities:					
IEC 61400-21 series					
IEC 61400-27 series					
IECRE OD-551-16					
EN 50549-10					
ENTSO-E – IGD General guidance on compliance testing & monitoring					
FGW TR3 – AG - Prüfstände					
Research Projects:					
Cert-Bench (Enercon, DEWI, Fraunhofer, FGH)					
Hil-Grid-CoP - Compliance on component level (Fraunhofer, Senvion, Nordex and Vestas)					
LIAISONS WITH INTERNATIONAL BODIES:			NEED FOR ISO COORDINATION:		
DOCUMENT MATURITY:					
<input type="checkbox"/> A DRAFT IS ATTACHED FOR COMMENT*			<input checked="" type="checkbox"/> AN OUTLINE IS ATTACHED		
* Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.					
CONCERNS KNOWN PATENTED ITEMS (SEE ISO/IEC DIRECTIVES, PART 1)			<input type="checkbox"/> Yes		<input checked="" type="checkbox"/> No
PATENT DESCRIPTION:					

WE NOMINATE A PROJECT LEADER IN ACCORDANCE WITH ISO/IEC DIRECTIVES, PART 1			
LAST NAME:	FIRST NAME:	E-MAIL:	COUNTRY:
Yang	Guangya	gyy@elektro.dtu.dk	Denmark

COMMENTS AND RECOMMENDATIONS FROM TC/SC OFFICERS:	
WORK ALLOCATION:	
<input type="checkbox"/> NEW PROJECT TEAM	<input type="checkbox"/> NEW WORKING GROUP
<input checked="" type="checkbox"/> EXISTING WORKING GROUP:	WG 21
IF APPROVED, THE NEXT STAGE SHOULD BE:	
<input checked="" type="checkbox"/> CD	<input type="checkbox"/> DTS

## REMARKS FROM TC/SC OFFICERS:

The proposal was briefly announced and presented at the online TC 88 plenary meeting on 3 May 2021. TC 88 welcomed the proposal.

Mr. Guangya Yang, gyy@elektro.dtu.dk, Denmark will be responsible for the project under WG 21.

IEC national committees with P-membership status wishing to participate in the development of this new project are invited to appoint experts; they can either choose existing members of WG 21 or appoint new experts for this project.

## APPROVAL CRITERIA

- Approval of the new work item proposal by a 2/3 majority of the P-members voting;
- At least 4 P-members in the case of a committee with 16 or fewer P-members, or at least 5 P-members in the case of committees with more than 17 P-members, have nominated or confirmed the name of an expert and approved the new work item proposal.

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