NGFANG ELECTRIC REVIEW

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DONGFANG ELECTRIC REVIEW

4
2021
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CONTENTS

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1. 611731 2. 618000

Workbench

Miner

PSD Miner

U469.72 TM911.4 A 1001-9006 2021 04-0001-05

Random Vibration Life Analysis of A Fuel Cell Power System Support Structure

1 1 2 1 1

1 1

(1. Dongfang Fuel Cell Technology Co., Ltd., 611731, Chengdu, China;

2. Dongfang Turbine Co., Ltd., 618000, Deyang, Sichuan, China)

Abstract: In recent years, fuel cell attracts people' s attention with its zero emission. The vehicle fuel cell power system support structure is fixed together with the vehicle frame. The system support structure carries the static and dynamic loads of the entire fuel cell, so its structural performance determines the stability of the fuel cell system under on-board conditions. This paper uses Workbench to analyze the random vibration of a fuel cell system support structure. The analysis shows that the fuel cell system can pass the durability random vibration test. The system support structure meets the vehicle durability requirements which damage assessment is based on with Gaussian distribution and miner´s linear cumulative damage law.

Key words: carbon neutrality; fuel cell power system; random vibration; PSD; Miner; damage

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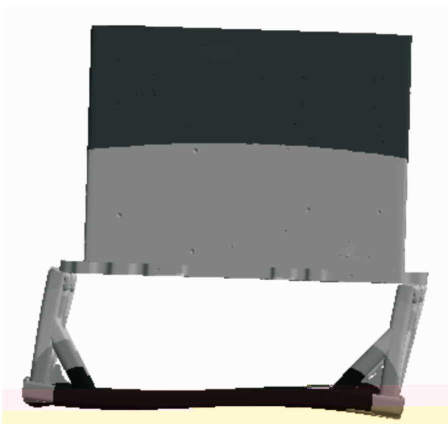

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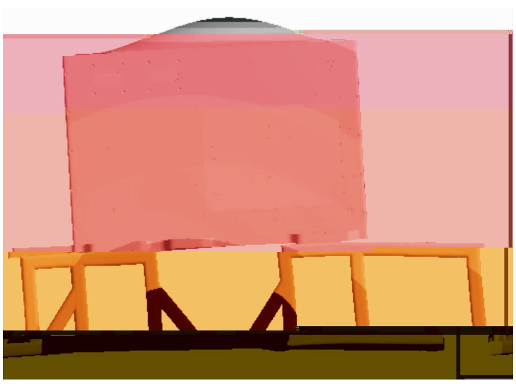

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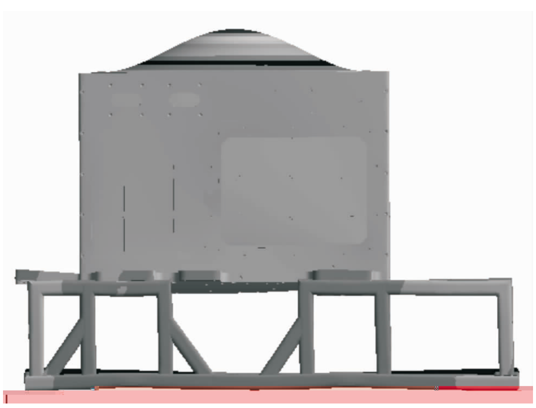

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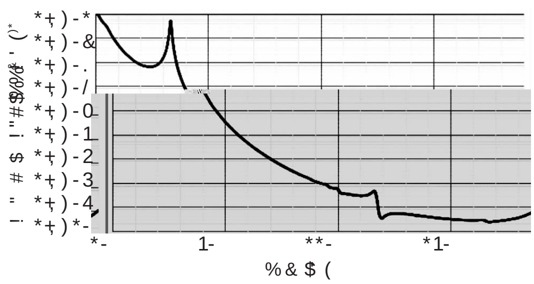

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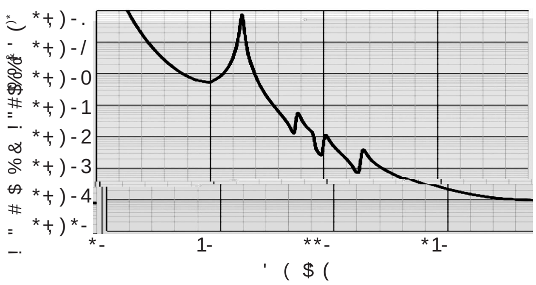

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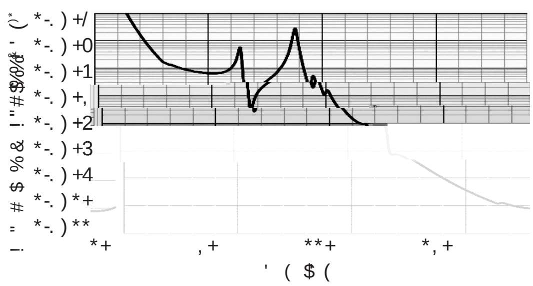

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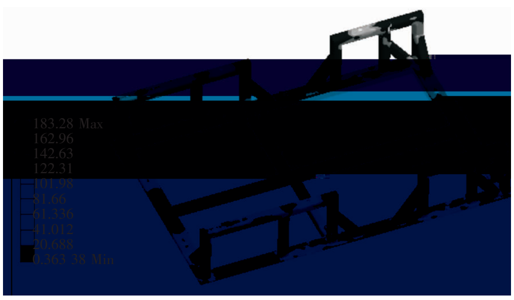

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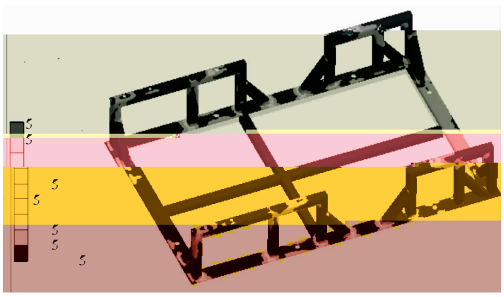

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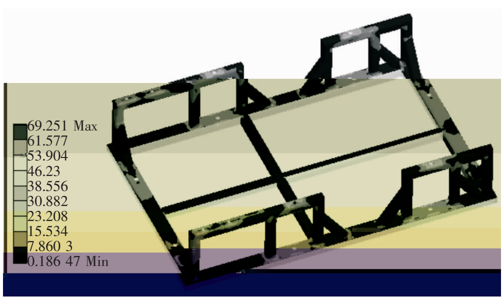

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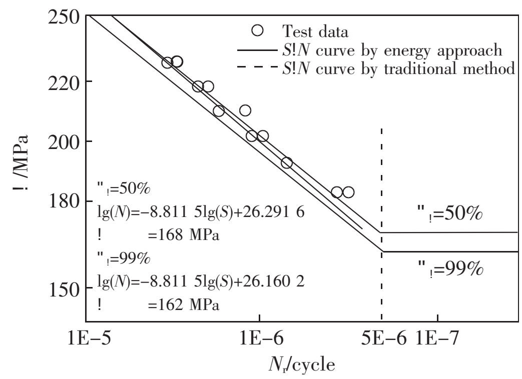

15 Q235 S-N [4]

8

$$= 4 \times 10^{6}$$

$_0^{+}$ = 5 Hz

$$_{1Á} = 0.683 \times \quad \times \ _0^{+} = 1.366 \times 10^{7}$$

$$_{2Á} = 0.271 \times \quad \times \ _0^{+} = 5.42 \times 10^{6}$$

$$_{3Á} = 0.043\ 3 \times \quad \times \ _0^{+} = 8.66 \times 10^{5}$$

12

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	61.1	+∞	122.2	+∞	183.3	1.65×10^{5}	0.52
	19.1	+∞	38.1	+∞	57.1	+∞	0
	23.1	+∞	46.2	+∞	69.3	+∞	0

9

GB 38031－2020

11

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1. 611731 2. 100824 3. 710049

TP393 A 1001-9006 2021 04-0006-06

Analysis of Network Security Elements of Energy Equipment

1 H 2 3 3

(1. DEC Academy of Science and Technology Co., Ltd., 611731, Chengdu, China;
2. National Energy Administration Information Center, 100824, Beijing, China;
3. Xi′an Jiaotong University, 710049, Xi′an, China)

Abstract: The intensification of cyberspace security confrontation gradually extends network security attacks from information domain to physical domain, network attacks from information systems to control systems and finally to energy equipment. The security elements of information system and control system are relatively clear, while the network security research of energy equipment is still relatively lacking. This paper analyzes the network security elements of energy equipment with the goal of ensuring the availability of energy equipment, and discusses the differences and relationships between energy equipment security and information system security and control system security.

Key words: energy equipment; cyber-physical systems; confidentiality; integrity; availability; network security

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IEC 62443 [1]

2.0 [2]

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yuanxs@dongfang.com

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3 Windshark

Windworm Telnet FTP

Windpoison ARP

[6]

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Colonial Pipeline

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ISA99/IEC 62443 －1 －1

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ISO/IEC 13335 －1 2004

Confidentiality

Integrity

Availability

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cyber-physical systems CPS 18－20

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22 CPS

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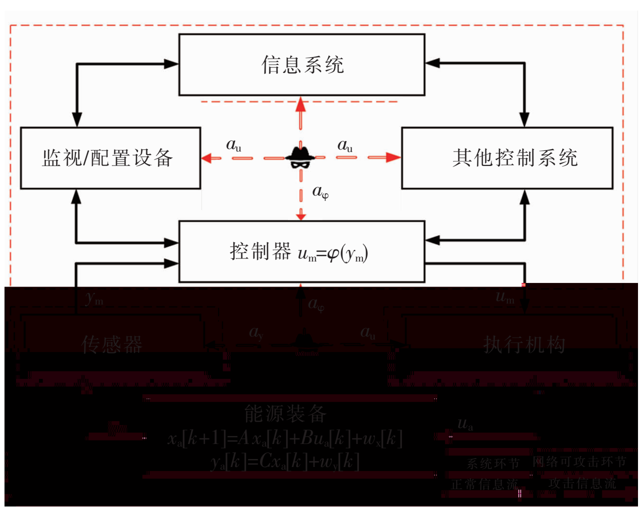

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5

Workbench

基于时间自动机的汽轮机控制保护系统建模

1 1 2 2 1

1.南京理工大学 南京 210094 2.东方电气能源装备工控网络安全工程实验室 成都 611731

摘要

UPPAAL

关键词 UPPAAL

中图分类号 TP393 文献标识码 A 文章编号 1001-9006 2021 04-0012-06

Modeling of Steam Turbine Control and Protection System Based on Time Automata

1 1 2 2 1

(1. Nanjing University of Science and Technology, 210094, Nanjing, China;

2. Academia Sinica of Dongfang Electric, 611731, Chengdu, China)

Abstract: In recent years, the safety threat of steam turbine control and protection system attracts extensive attention from academia and industry. Different from the previous attacks on communication protocols, the attacker gradually shifts the target to the controller itself. In order to deal with this new threat, scholars begin to study how to establish an effective model of the controller to describe and analyze the impact of this attack on the system operation, and then design timely and effective defense strategy. On the basis of summarizing the relevant research, this paper proposes a formal method based on time automata to model the turbine protection system. At the same time, UPPAAL software is used to simulate and verify the established model. The results show that the proposed model can describe the working process of steam turbine control and protection system well, and lay a foundation for subsequent safety research.

Key words: steam turbine control and protection system; time automata; UPPAAL

“ ” “ ”

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ZKZF200001

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1999 - 2021

1973 - 2013

yuanxs@ dongfang. com

1985 - 2012

sangzi@ dongfang. com

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1 UPPAAL

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UPPAAL

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10 ~ 11

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Close1 Open1

open1

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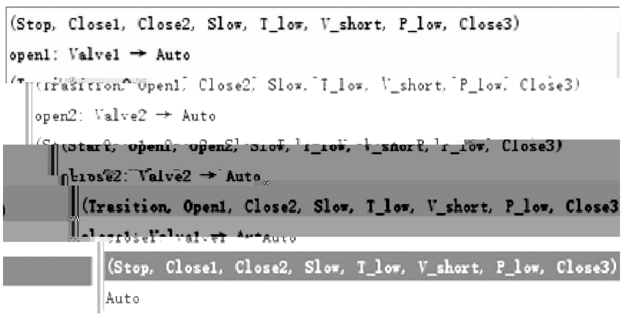

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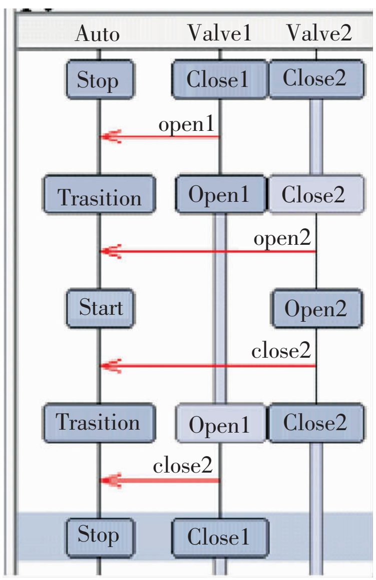

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Open2 open2

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stop2 =

1

close2

stop1 = 1

close1

4. 2

4. 1

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12 ~ 14 3 300

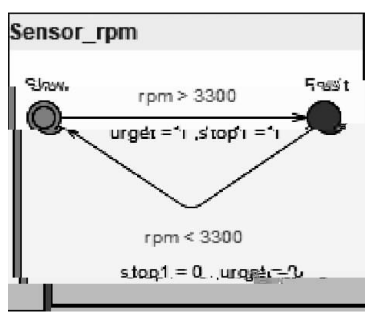
Slow

Fast stop1 = 1

urget = 1

Close3 Open3

urget_close



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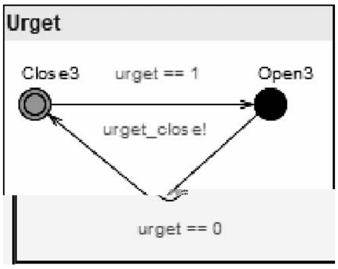

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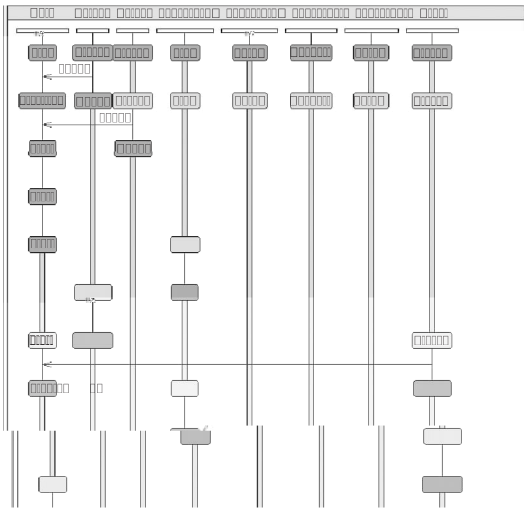

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TQ326.9 A 1001-9006 2021 04-0018-05

Study on the Aging Characteristics of the Main Insulation Composite Caterial of the Large Generator Stator Bar under Multiple Working Conditions

(DEC Academy of Science and Technology Co., Ltd., 611731, Chengdu, China)

Abstract: Aiming at the thermal/oxygen aging of the main insulation composite material of generator stator bar, artificial accelerated simulated aging experiments under high temperature and high temperature/oxygen environment were carried out respectively. Studies show that oxygen accelerates the aging degradation reaction of the free radical reaction mechanism caused by high temperature during the aging process, generates a large number of free radicals during the aging process, and accelerates the destruction of the molecular network structure. The participation of oxygen accelerates the rapid decrease of free radical content and aggravates the aging degree of materials. As the aging progresses, the interaction force between different phase structures decreases, resulting in a large number of fragmented structures on the surface. This study provides the basic data of material evolution for the life assessment of large generator insulation system and promotes the improvement of the accuracy of the assessment.

Key words: main insulation; epoxy composite; aging

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FTIR Thermo Fisher Scientific Thermo Scientific™ Nicolet™ iS50

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X XPS Thermo Fisher Scientific EscaLabXi + X

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SEM FEI Nova NanoSEM 450

KEYENCE VHX-2000 100 300 500 700

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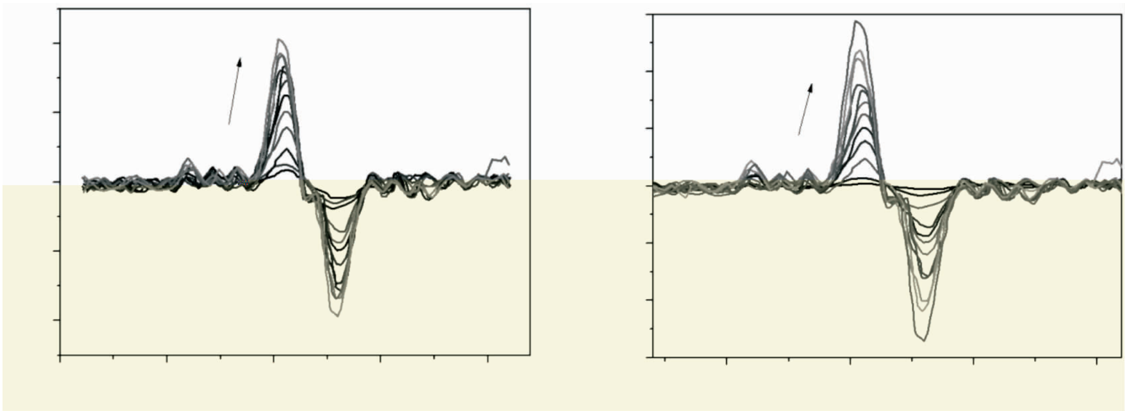

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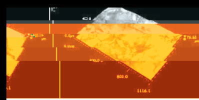

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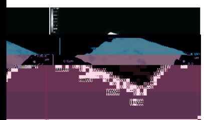

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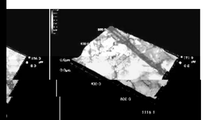

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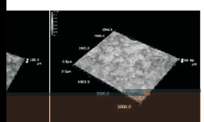

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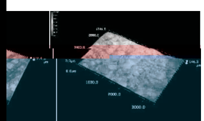

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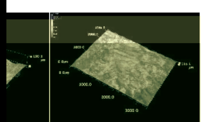

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611731

PECVD

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110%

26%

TB383 A 1001-9006 2021 04-0023-06

Preparation and Properties of Hydrophobic Graphene/Cu-Ni Alloy with High Heat Transfer Coefficient

2021 － 10 － 22

1984 － 2011

OM Olympus
DP71 Raman Labram HR800-UV-NIR 532 nm 10% －10mW

Attension Theta

D20 mm × 1 mm × 600 mm

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2.1

[12－15]

[15] 1

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[15] 1 000 ℃ I_G/I_{2D} 0.67

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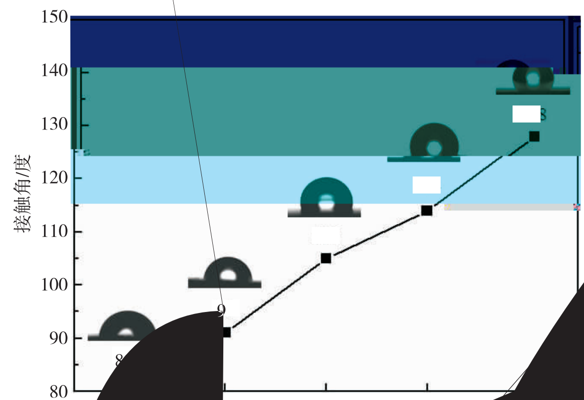
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7 Reina Alfonso Jia Xiaoting Ho John Nezich Daniel Son Hyungbin Bulovic Vladimir Dresselhaus Mildred S. Kong Jing. Large Area. Few-Layer Graphene Film

618000

Ansys Workbench

TB12 A 1001-9006 2021 04-0029-05

Research and Analysis on Assembly Dynamic Characteristics of Permanent Magnet Direct Drive Wind Turbine

(Dongfang Electrical Machinery Ltd. , 618000, Deyang, Sichuan, China)

Abstract: This paper describes the use of Ansys Workbench finite element software to build a permanent magnet direct-drive generator assembly model, using electromagnetic coupling to calculate the natural frequency of the generator assembly, that is, considering the uniform magnetic pull of the rotor permanent magnet and stator core, And the influence of eccentric magnetic pull due to deformation of the machining, assembly, rotor bracket and stator bracket itself. The accuracy of the method is verified by comparing the calculated results with the measured results of the modal test.

Key words: finite element method; electromagnetic coupling; dynamic characteristics; modal test

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ANSYS

2021－09－24

1988－ 2019

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Lanczos

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Lanczos

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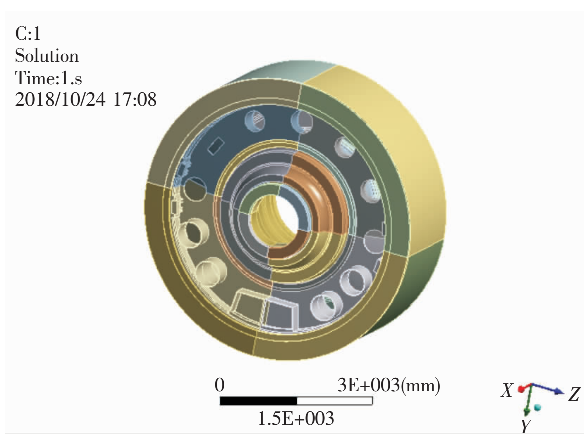
Edge Size Body Size

Solid186 Solid187

Link180 Beam188



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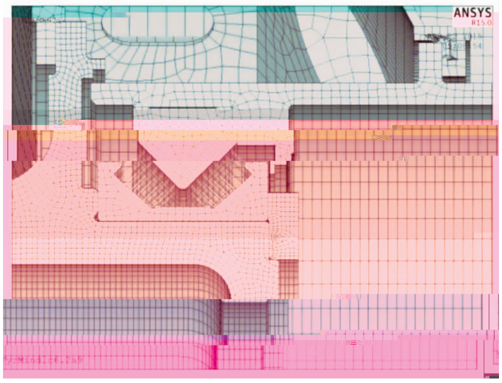

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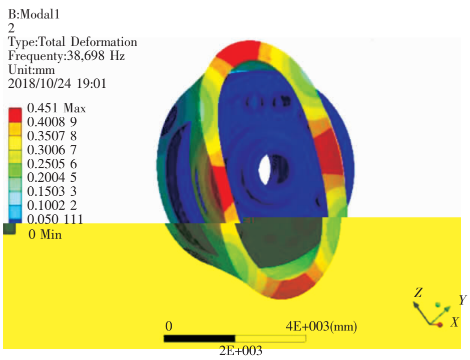

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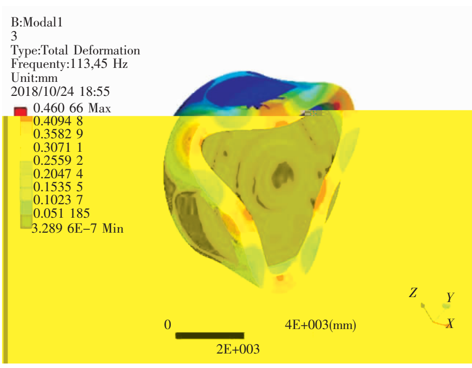

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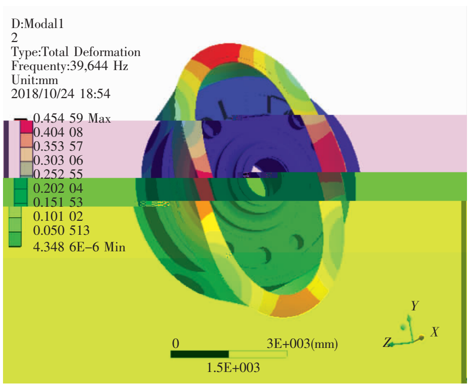

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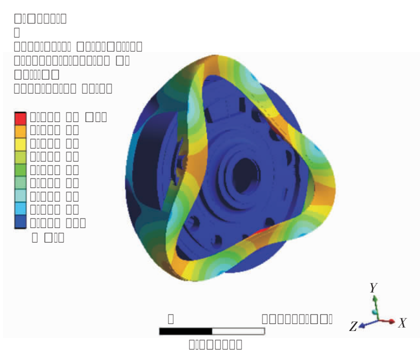


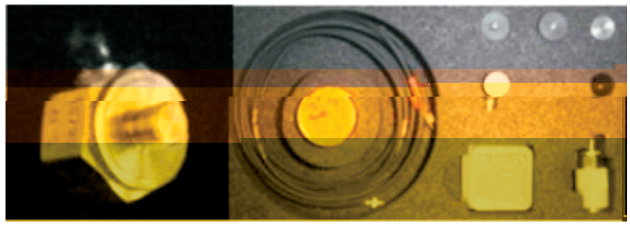
9 107.66 Hz

3

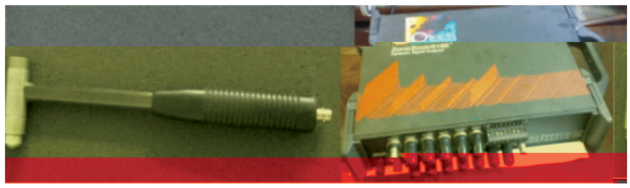
3.1

10 PCB

A B C



a PCB



b c

10

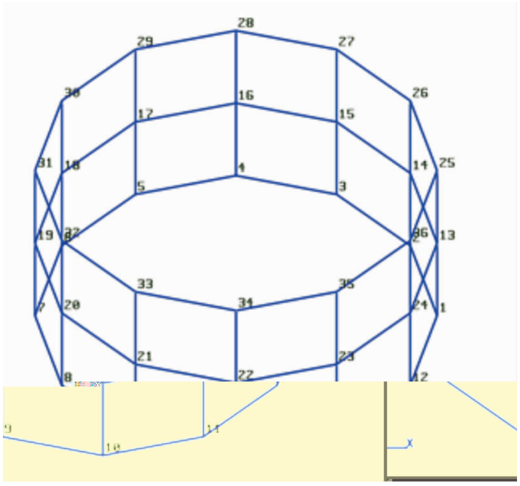
3.2

modal test

SIMO

“ ”

11



11

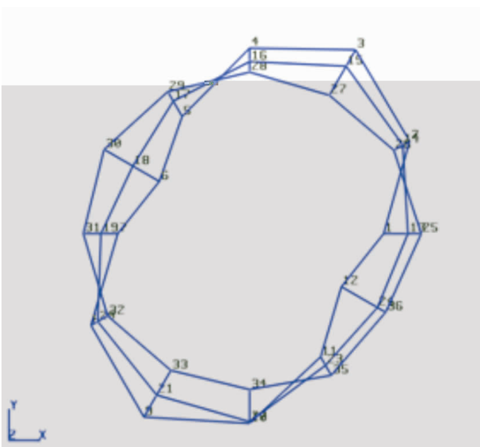
3.3

4

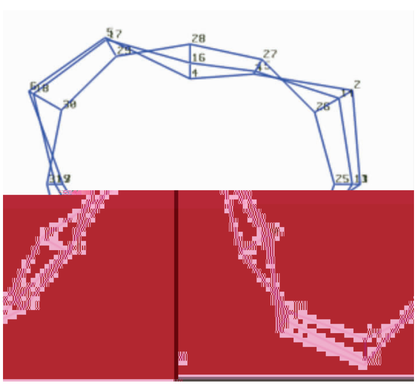
12 13

4 Hz

1	40.1
2	103.9



12 40.1 Hz



13 103.9 Hz

4

5

6

5 Hz

1	40.1	38.698	39.644
2	103.9	113.45	107.66

6 %

1	-3.50	-1.14
2	9.19	3.62

6 8 12 7 9

13 5

5

1 2

2

3.62%

9.

19%

3

4

46

VPN

1 2

1. 618000 2. 735000

VPN

VPN

SCADA

TM614 A 1001-9006 2021 04-0034-04

Application of VPN in Centralized Monitoring of WTGs

1 2

(1. Dongfang Electric Automatic Control Engineering Co., Ltd., 618000, Deyang, Sichuan, China;

2. Jiuquan Vocational Technical College, 735000, Jiuquan, Gansu, China)

Abstract: It is essential for off-site monitoring of WTGs to enhance remote management of wind farms, to reduce WTG operation and maintenance costs, to check and eliminate potential safety hazards. A remote monitoring center can not only achieve cost-saving purposes through a virtual private network (VPN), but also meet the requirements of the State Electricity Regulatory Commission' s "Safety Protection Regulations for Secondary Power Systems". This paper analyzes and discusses the remote monitoring and safety of WTGs through VPN.

Key words: virtual private network (VPN); remote monitoring; WTG; network security; SCADA

SCADA SCADA

SCADA

1

APP

SCADA "

2021 - 06 - 01

1984 - 2007

”

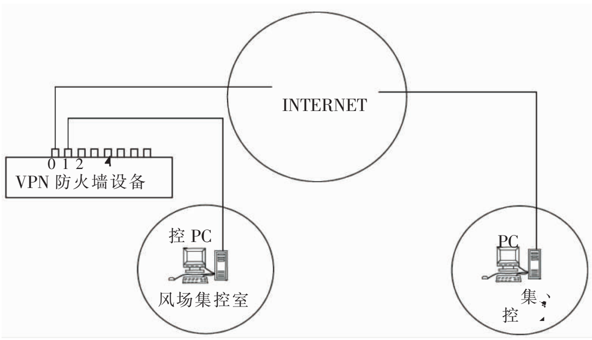
1

2

Internet

ᾰ̋

6



1 VPN

2. 2 SCADA

SCADA

USB

U USB

VPN

4 VPN

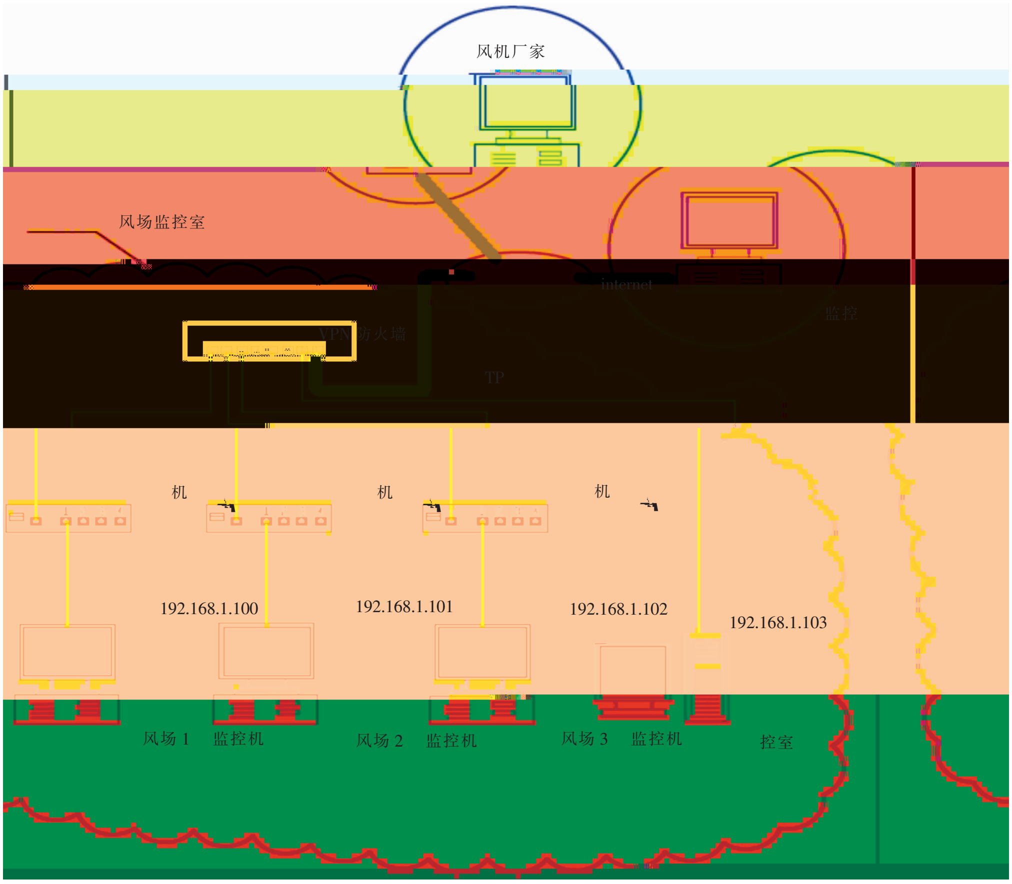
VNC

5 VPN

VPN

VNC SCADA

SCADA



2 VPN

3

VPN VPN

VPN

VPN

1 . J .
2014 6 137

2 . R . 2005

3 . J .
2013 32 6 23 – 25

4 . Internet SCADA
J . 2006 17 89 – 93

5 . IPSec VPN J .
2014 22 20 139 – 141 + 145

6 . VPN
J . 2011 3 =

CANopen

611731

CANopen
TMS320F28377D CAN
Controller Area Network CANopen PLC Programmable Logic Controller

CANopen PLC CAN
TM614 TP273 A 1001-9006 2021 04-0038-04

Development of CANopen Communication Function for Wind Power Converter Control System

(DEC Academy of Science and Technology Co. , Ltd. , 611731, Chengdu, China)

Abstract: The intelligence of wind power system is an important trend, so the development of an independent, flexible and open converter communication system becomes an important task. CANopen communication has the advantages of simple hardware structure, strong anti-interference ability, and high real-time performance, so it is widely used in the field of industrial control. This paper developed CANopen communication function based on the CAN (Controller Area Network) module of TMS320F28377D, so that it could be used in wind power control systems with PLC (Programmable Logic Controller) as the main controller. Finally, the reliability and accuracy of the developed communication function were verified through experiments.

Key words: CANopen; converter; PLC; CAN

CAN Controller Area Network
BOSCH

[1] CAN
[2] CAN
CAN

2021 - 05 - 21
2020YFG0315
1992 - 2020

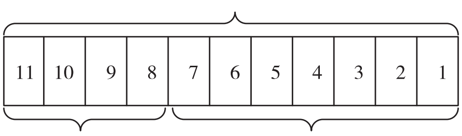
32
SDO 32
SDO
3 PDO PLC

PDO TPDO
RPDO PDO 8
PDO

4 PLC SYNC
PDO

3 CANopen

CANopen 11 CAN-
ID COB-ID Communication Object
Identifier
4
7
3



4 CANopen

TMS320F28377D
CANopen DSP CAN
PLC CAN
LINK CAN

1 1 1 2 3 4 4 4

1. 611731 2. 618000
3. 611731 4. 618000

2021－11－04

1980－ 2010

“ ”

6 17

“ ”

1

1

1

1

2

3

4

5 6% 70%

23%

6

7

8

9

+ + + +

η

2

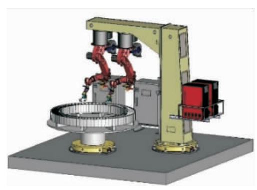
“

”

2. 1

1

1

	14 m × 14 m ×5 m	GMAW GTAW GMAW	1 30% 2 3	
	6 m ×6 m ×5 m	GMAW	1 35% 2 3	
TIG	6 m ×6 m ×5 m	TIG	1 45% 2 50% 3 2 1	

2. 2

2

2

2. 3

2

2

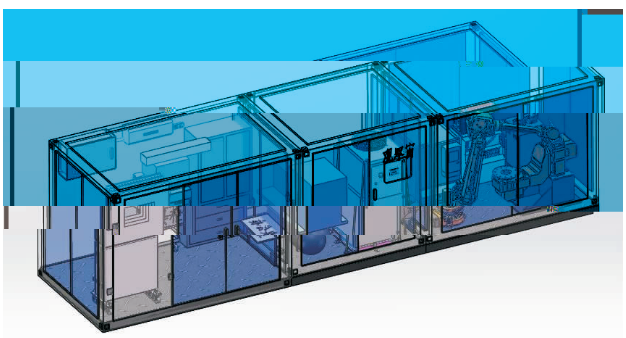
	1 1/24 2 80% 3 4 90%	
TIG	1 1/4 2 1/5 3 RT 60% 99% 4	

2.4

“ ”

3

“ ”



3

3

1

2

4

5

4

33

1 .
J . 2018 45 9 117 – 124
2 . M . 1986

“ ”

11 1
D705

VM60

VM60

1 . M .
2015 289
2 . J .
2019 1 146 – 147

3 . J . 2016 26
16 94
4 . J .
2001 4 436 – 439
5 .
J . 2015 29 2 67 – 71 + 75
6 . ANSYS10.0 M .
2007
7 . ANSYS J .
2018 18 10 120 – 122
8 . M . 2003

VM60 19
“ ”

来源 东方电气网

611731

SA－335P92

F426 A 1001-9006 2021 04-0047-02

Boiler Industry Import Large-calibre Pipe Procurement Dilemma and Countermeasures

(Dongfang Boiler Group Co. , Ltd. , 611731, Chengdu, China)

Abstract: This paper analyzes the procurement status and difficulties of imported large-diameter pipes (SA-335P92 and other materials) , puts forward countermeasures, achieves good results, saves procurement cost and ensures delivery cycle.

Key words: imported large-diameter pipes; procurement difficulties; measures; results

SA-335P92

1

SA-335P92
Valllourec Deutschland GmbH

2021－10－18
1970－ 1991

1

2 D720

60% D720

SA-335P92

3% ~5%

3

4

6

5

2

2020 3

2020 6 30

Reisholz

Reisholz

SA-335P92 2 ~3 t

3

1

2

3 D720

4 IBF

SA-335P92

5 SA-335P92

P92

4

2020 10

2020 12

6 2021 1

1 2021 06 30 2021 12

30 2021 SA-335P92

1.2

54

1 2 燊 1 2 1 2 1 2 1 2 1 2 1 2

1 2 1 2 1 2 1 2

1. 611731 2. 643001

17.5 MPa/571/569 ℃

NOx

TM621 A 1001-9006 2021 04-0049-06

Brief Introduction of Dongfang Ultra High Temperature Subcritical Blast Furnace Gas Fired Boiler

1 2 1 2 1 2 1 2 1 2

1 2 1 2 1 2 1 2 1 2 1 2

(1. Clean Combustion and Flue Gas Purification Key Laboratories in Sichuan Province, 611731, Chengdu, China;
2. Dongfang Boiler Group Co., Ltd., 643001, Zigong, Sichuan, China)

Abstract: This article introduces the design scheme of ultra-high-temperature subcritical (17.5 MPa/571/569 ℃) gas fired boiler developed by Dongfang Boiler Group Co., Ltd. and its design features are introduced and summarized. The development and design of the gas fired boiler can meet the needs of the development of the gas fired boiler with larger capacity and higher parameters, and improve the unit efficiency and power plant economy.

Key words: ultra-high-temperature subcritical; gas fired boiler; furnace type selection; Low-NOx combustion technology

88.7% [1]

[2-3]

[4]

–

[5]

100 MW

[3 6] 37% [3]

[7-8]

2018

1

2021-02-24

1979- 2013

1

1.1

CO 20%

N_2 CO_2

2 800 ~ 3 800 kJ/Nm^3

1

2

3

1.6 ~ 1.8 1 m^3

0.595 ~ 0.85 m^3

1.6 ~ 1.8 m^3

[9]

[10]

4

1

	N_2	H_2	O_2	CO	CO_2	CH_4	C_mH_n			H_2S
				%				kJ/Nm^3	mg/Nm^3	mg/Nm^3
	51.3	3.8	0.1	22.1	22.7	0	0	~3 200	<10	–
	27.8	2.3	0.1	53	16.6	0.2	0	~7 000	<10	–
	4.9	59	0.5	5.8	4	24.1	1.7	~17 500	<10	050

1.2

CO

50% 6 500 ~ 7 800 kJ/Nm^3 1

1.3

H_2 CH_4

85%

16 000 ~ 18 500 kJ/Nm^3

1 800 ℃

2.2

50%)

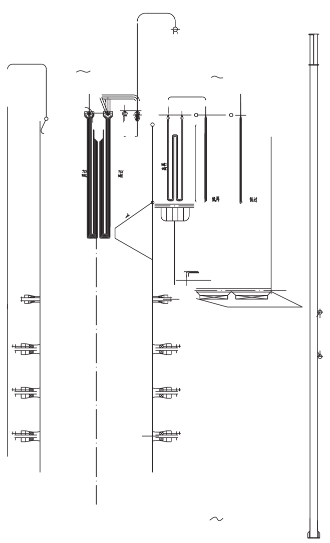
1

NOx

1

2

3



SA －213TP347H

4

－

5

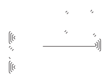
SCR

6

7 SCR SCR

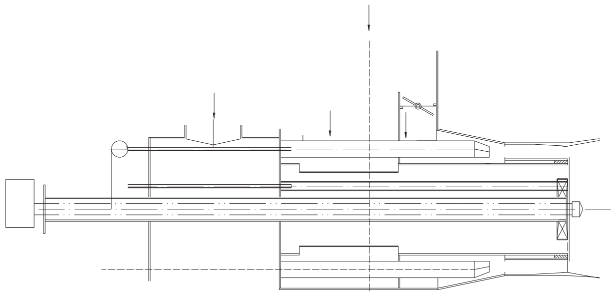
NOx SCR NOx

50 mg/m^3



NOx

65%



55 ~ 80 MW 150 MW

1 . 2012 12

R . 2012

2 . 2 J .

2019 9 64 – 68

3 .

J . 2018 8 63 – 64 + 137

4 D .

2017

48

5 . 135 MW –

J . 2014 45 4 23 – 26 + 44

6 .

J . 2015 12 35 – 38

7 . 100 MW

J . 2019 10 70 – 73

8 . 110 MW

J . 2019 6 5 – 8 + 28

9 . J .

2015 44 3 21 – 27

10 .

J . 2014 28 3 169 – 172

11 .

J . 2019 2 60 – 64

12 .

D . . 2018

1 2

1. 613001 2. 618000

TH16 V263 A 1001-9006 2021 04-0055-04

Method of Using Lapped Jiont Profile Disk Milling Cutter to Decrease Deformation and Vibration of Thin Wall Part

1 2

(1. Southwest Jiaotong University, 610031, Chengdu, China;
2. Dongfang Electrical Machinery Co., Ltd, 618000, Deyang, Sichuan, China)

Abstract: Thin wall part is easy to deforming when it is milled, because of its low strength. What is more, As its low stiffness, thin wall part is more likely to vibrate. This will decrease machined surface roughness. This paper presents that using indexable disk milling cutter, further subdivision of finish milling, one time to complete the ordinary finish milling and wiper finish milling, exploring the optimal cutting parameters can decrease cutting force and vibration of thin wall part, improve processing quality and efficiency. Furthermore, a processing example is utilized to demonstrated the validity of those method.

Key words: thin wall part; milling; processing deformation; processing vibration

1/5 − 1/8 [5-6]

[1]

[2]

[3]

[4]

2021 − 07 − 01

1987 − 2010

1

1.1

1

1/8

Cr Ni Mo V

±0.02 mm

150 mm 0.9

m^2

30

1

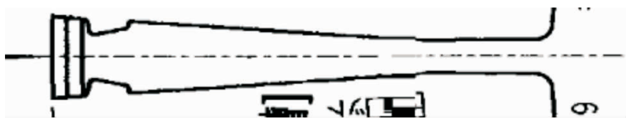
7

1

1.2

2

3



2

3

0.12

~0.31 mm

d Ä50 mm

$_c$ =60m/min = $_c$/ ¿ * 382 r/

min =5

= × * 1 910 $_F$ =

/60 * 31.8 Hz

$_2 = 190 \sim 220$ r/min

$_{F2} = {}_2 \times$ /60 * 15.8 ~ 18.3 Hz

2

2.1

20 50

0.01 mm

160 m/min

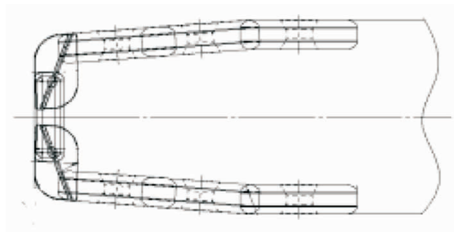
2.2

“ ”

4 5

0.005 mm

4



5

2.3

[8]

0.02 mm

2.4

2.4.1

$Ą_1$ =

500 mm

$_1 = 110$ mm

$_2 = 90$ mm $Ą_2 = Ą_1 + 2 {}_1 + 2 {}_2 = 900$ mm

2.4.2

1.2

31.8Hz $_2$ * 15.8 –18.3Hz

ASME

511455

ASME

TH121 A 1001-9006 2021 04-0059-03

Analysis on the mt o a a

2021－01－08

1983－ 2007

Miller

ASME ϐ Ŕ Í Ŕ

618000

0.9

TM153 A 1001-9006 2021 04-0062-04

3D FEM Analysis about Stator Winding Force

(Dongfang Electric Machinery Co. , Ltd. , 6W

2021 - 02 - 13

1986 - 2012

3

S2 S3 S1

1

S1

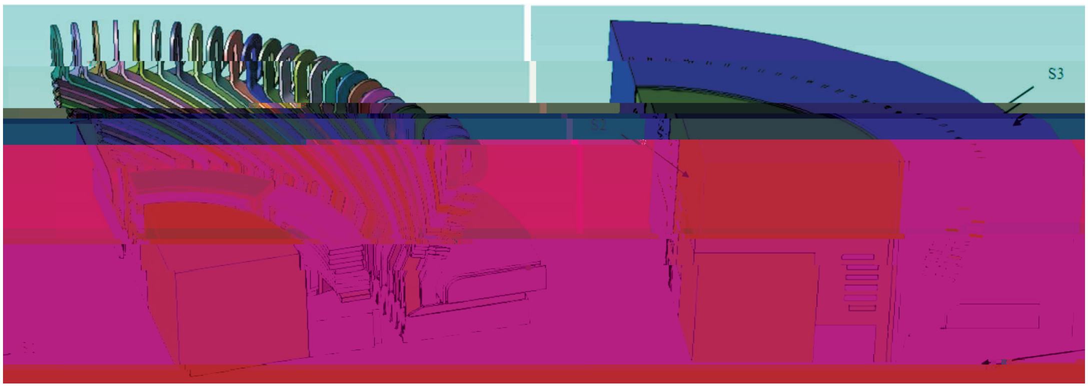
x y

z 0

3

S1

1



1

9.60×10^{6} N/m^{3} 3

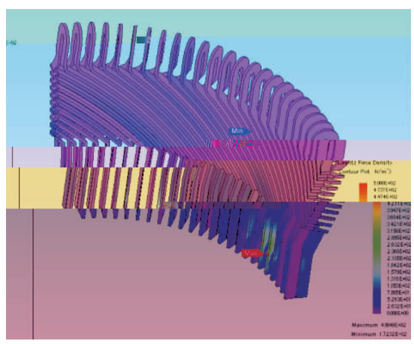
2.34×10^{6} N/m^{3}

2

2.1

0 2

490 N/m^{3}

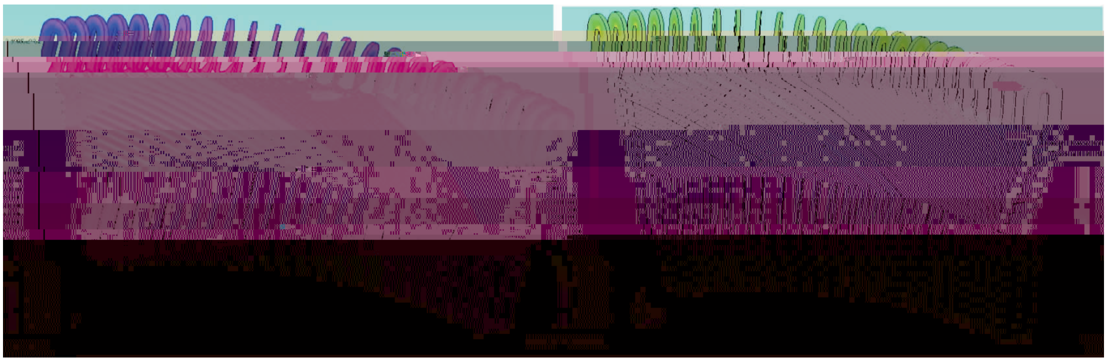


2

1

2.2

3 3



3

1

N/m^3

	1	2	3	4	5	6
	3.90E6	4.57E6	6.17E5	7.16E5	5.79E5	6.75E4
	2.22E6	1.75E6	-1.88E5	6.40E5	3.39E5	-1.34E4
	1.95E6	2.54E6	3.80E5	1.89E5	-3.15E4	-5.08E3
	-0.014 4	-0.722 63	4.47E5	6.90E4	-5.57E4	5.31E4

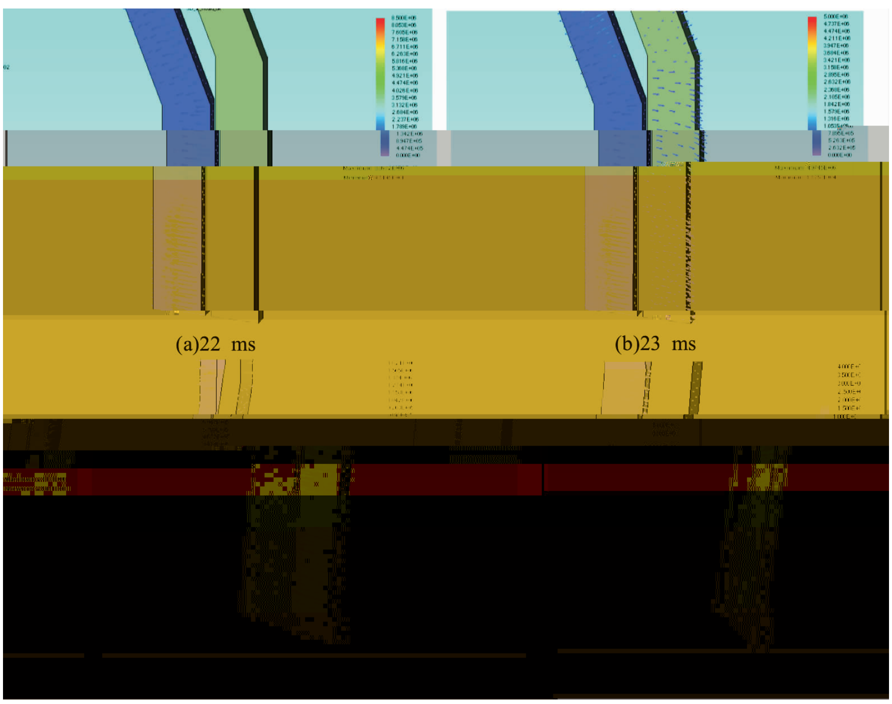
24 ms

4

22 ms

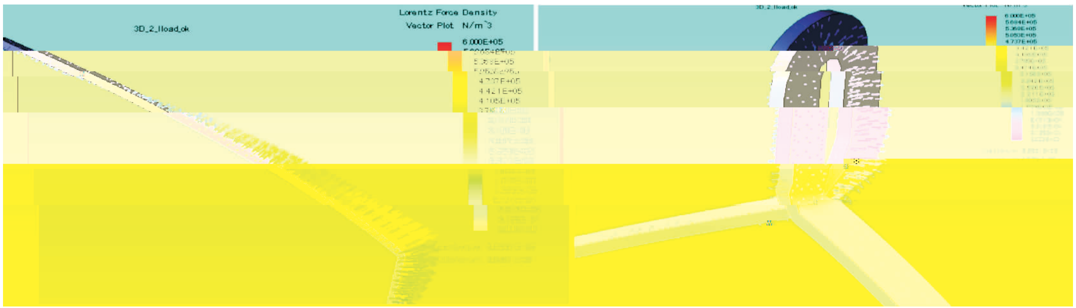
29 ms

23 ms



4

5



5

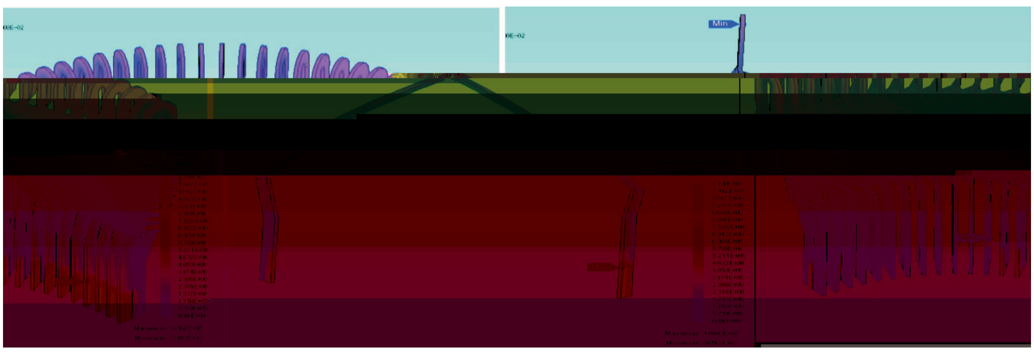
2.3 0.9

6

1.04×10^7 N/m^3

0.9

2



6 0.9

2 0.9

N/m^3

	1	2	3	4	5	6
	4.89E6	5.07E6	7.98E5	1.17E6	7.93E5	5.34E4
	3.18E6	4.16E6	6.94E5	1.04E6	2.22E4	5.21E3
	2.43E6	2.60E6	3.80E4	4.08E5	5.97E5	5.78E3
/N/m^3	−0.813 3	−2.049 4	−1.79E5	−5.69E4	−5.16E5	−3.32E4

1 2 0.9

0.9

10%

3

1

0.9

10%

71

“ ”

618000

“ ” “ ”
“ ” “ ”

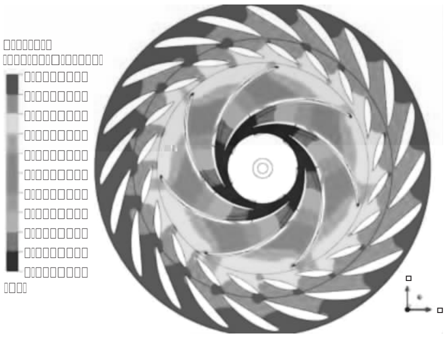
F426.4 A 1001-9006 2021 04-0066-06

Overview of the Innovation-driven Development of Dongfang Electric in the 13th Five-Year Plan

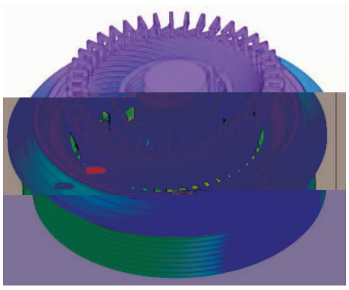
(Dongfang Electric Co. , Ltd. , 618000, Deyang, Sichuan, China)

Abstract: This paper briefly reviews the main achievements of the innovation-driven development of Dongfang Electric Machinery Co. , Ltd (DFEM) “13th Five-Year Plan”, after the “13th Five-Year Plan” period of innovation drive, the comprehensive technical strength of DFEM reached the leading domestic and international advanced level. d

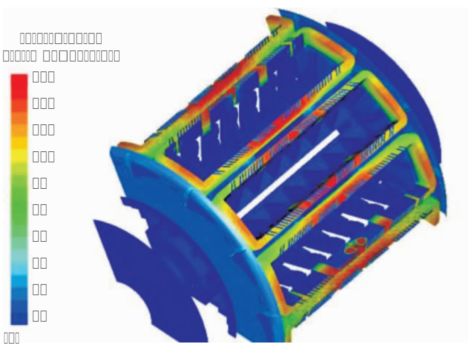
2021 －08 －30
1964 － 1996
1965 － 2012



1

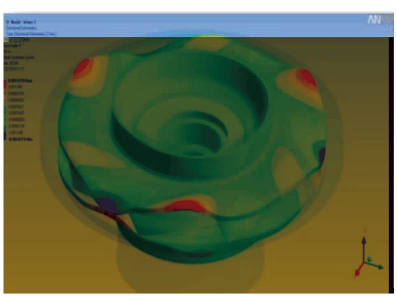


2

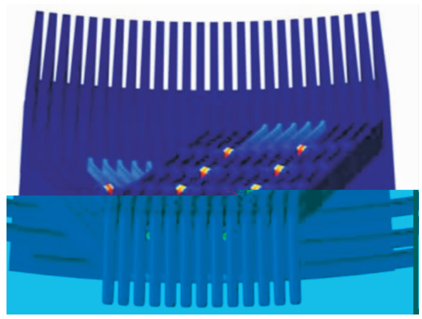


3

4



5



6

7

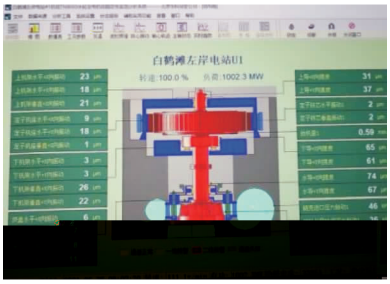
8

2

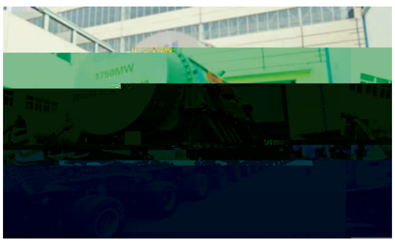
“ ”

1 000 MW 9 ~ 10 1 750 MW

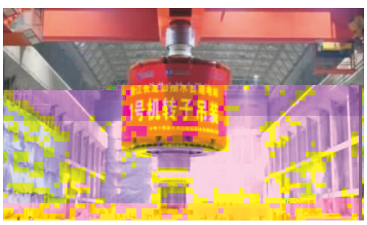
9　1 000 MW



10　　　　　　1



11　　　　　　ERP1 750 MW



12

13　10 MW

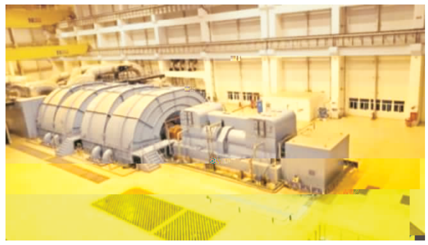
300

MVar

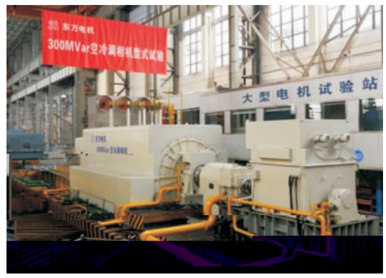
15

50 MVar

50 MVar　　　　　　16



14



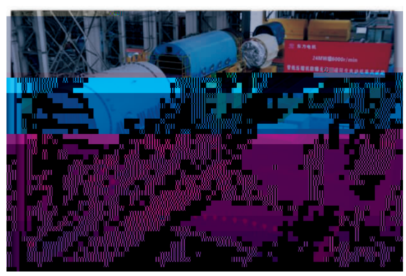
15　300 MVar

16　50 MVar

24 MW　　6 000 r/min

33

17



17　24 MW

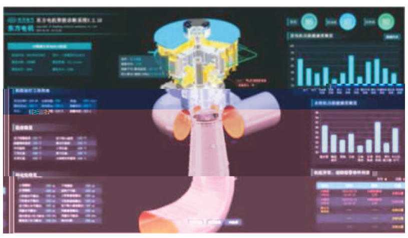
50 Hz 60 Hz 2 4
4
300 MW 600 MW
6 MW ~
165 MW
3 21

3

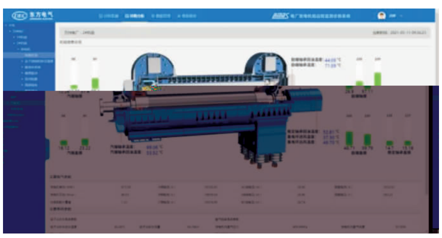
“ ”

3.1

18 ~ 19



18



19

3.2
“ ”

20 ~ 21
9 000 12 000
620% 56.6%

90%

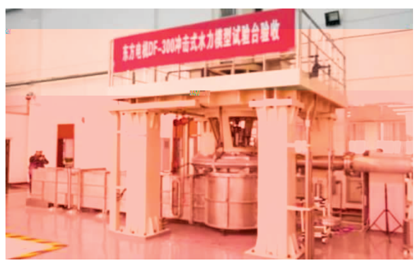
“ ”

20

21

3.3

DF－300 22



22 DF300

4

“ ”

4.1
“ ” “

” 10

23

23 “ ”

4. 2

“ ”

56 24 ~ 26

2 1 1

22

2 4 2 1

369 280

69

24

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“ ”

“ ”

25

26

5. 1

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6

5. 3

5. 4

65

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TM62 A 1001-9006 2021 04-0072-04

Research and Analysis of Steam Turbine Crisis Trip Device Based on High Frequency Solenoid Valve Control

(Dongfang Electric Automatic Control Engineering Co., Ltd., 618000, Deyang, Sichuan, China)

Abstract: In this paper, a new type of high frequency solenoid valve structure and the working principle, to establish the simulation model of solenoid valve, by means of the mechanical parts of the electromagnetic loop, and the coupling between the hydraulic system simulation, the solenoid valve static and dynamic simulation results more accurate, and the applications of the high frequency solenoid valve to a steam turbine crisis trip device, completed by simulation software based on steam turbine critical of the high-frequency solenoid valve control block device simulation model is established, through the simulation of various working conditions is critical in the interrupt turbine working state, It is further verified that the critical block device of steam turbine based on high frequency solenoid directional valve has high dyT c t

2021 - 09 - 24

1983 - 2010

“ ” “ ” “ ” “ ”

4

$$
\begin{cases}
\text{— } = \dfrac{1}{\quad + \text{—}} \quad - \quad - \quad \text{—} \\
{}_{m} = - \text{—} \\
\ddot{} = {}_{m} - {}_{spring} \pm {}_{w} - {}_{z} \\
{}_{w} = {}_{d}\ {}_{v}\ \text{“}\ \sin 2 \cdot
\end{cases}
$$

1

1

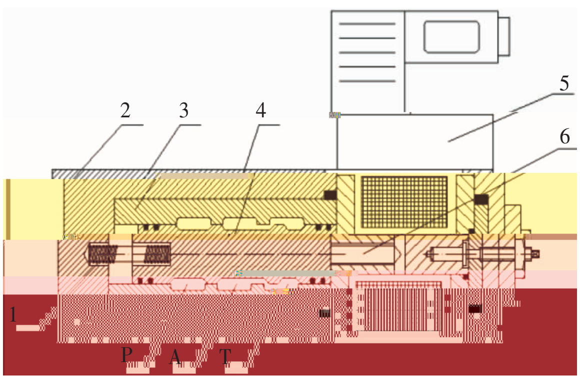
$$| \quad | =$$

$= \quad = \text{—} \quad {}_{m}$

${}_{spring} = \quad + {}_{0} \quad {}_{w} \quad {}_{z}$

1

1



1 – 2 – 3 – 4 –
5 – 6 –
1

5

4 1

T A

6

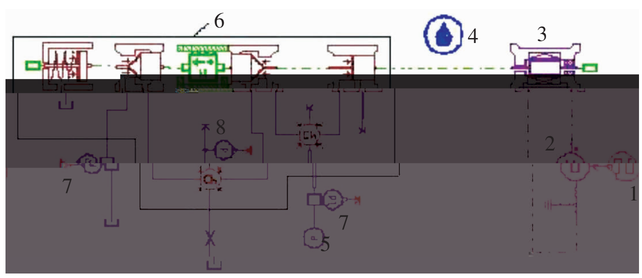
4 P A

2

4

3

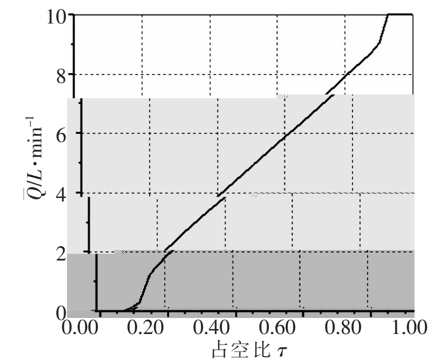
2



1 – PWM 2 – 3 – 4 –
5 – 6 – 7 – 8 –
2

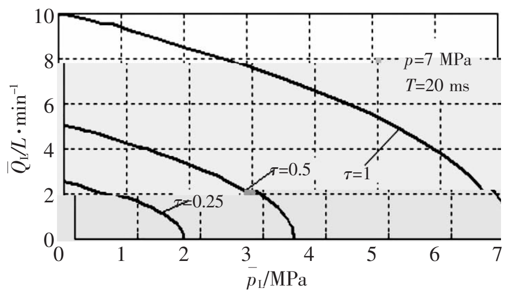
3

0.2 ~ 0.8


$\bar{Q}$/L·min^{-1}
占空比 τ
0.00 0.20 0.40 0.60 0.80 1.00
0 2 4 6 8 10

3

4

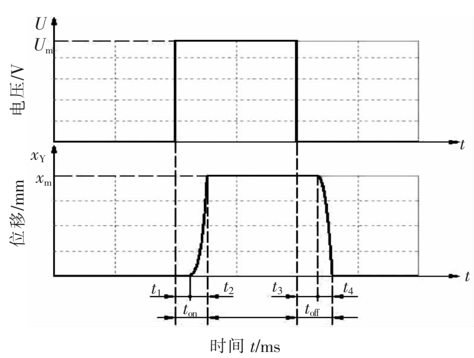

$\bar{Q}_l$/L·min^{-1}
$\bar{p}_l$/MPa
p=7 MPa
T=20 ms
τ=1
τ=0.5
τ=0.25

4

5

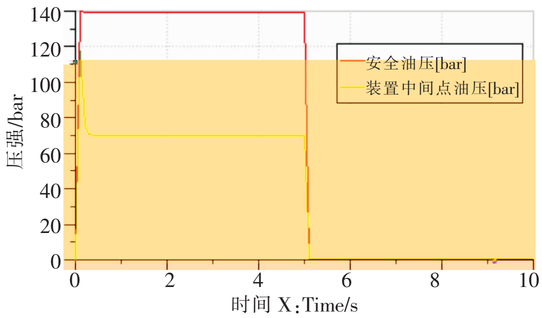
on

off


U
U_m
电压/V
t
x_Y
x_m
位移/mm
t_1
t_2
t_3
t_4
t_{on}
t_{off}
时间 t/ms

5

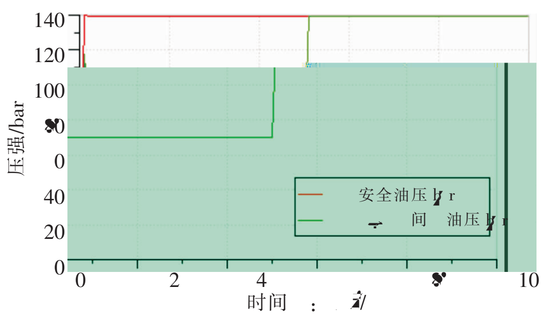
140 bar
4
5 s
4
0.2 s 139.6 bar 4
0.2 s 0.1 bar
4
0.3 s 69.8 bar 4
0.2 s
0.5 bar 9



9

SV1 SV2 5

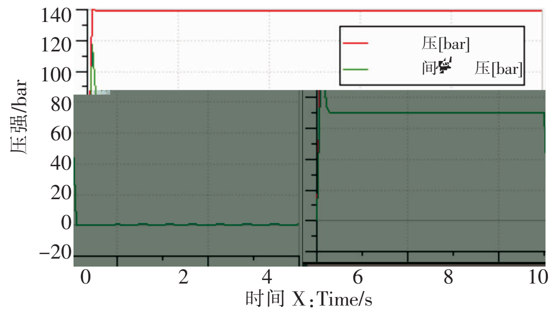
SV1
SV2 0.2s 139.1bar
10



10 1

SV3 SV4 5 s

SV1
SV2 0.2 s 0.7 bar
11



11 2

5

1

2

1 . J .
2000 4 5 – 6
2 . Ansoft AMESim
J . 2008 9 104 – 105 + 108
3 . J .
2004 15 84 – 88
4 . M .
2005.6
5 . M . 2002
6 . M . 2008
7 S . 2006 DL/T996
– 2006

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TM311 A 1001-9006 2021 04-0076-05

Advantages of Evaporative Cooling Technology in Large Generator-motor and Its Simulated Test

(Dongfang Electrical Machinery Co., Ltd., 618000, Deyang, Sichuan, China)

Abstract: Stator coils of large turbo-generators are water-cooled. Traditional hollow strand is made of copper with low loss, but the inner wall of hollow strand is scaled and corroded. It is easy to cause strand blockage or even water cut-off andg

2021 – 04 – 06
1980 – 2002
1970 – 1995

[1]

[2]

1

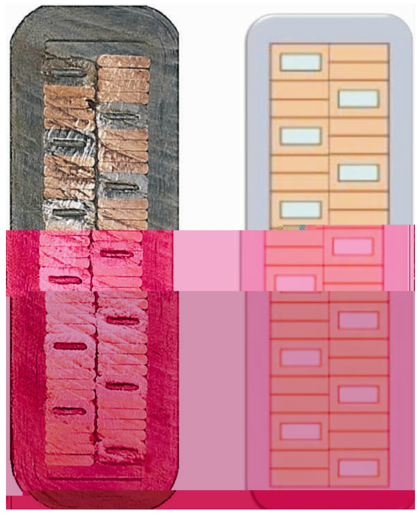
1

[3]

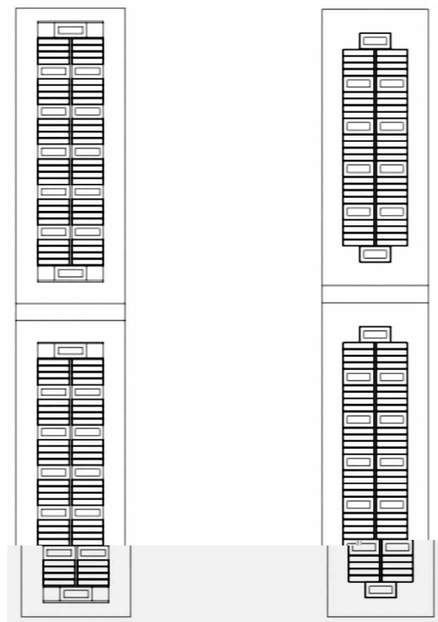
1 2 1 4

2a

2b



1



a b

2 1 4

3

1

1

/ 1 2

r 0

Á

5 AB CD

Dirichlet AE BF

Neumann

540°

In U R

R

a

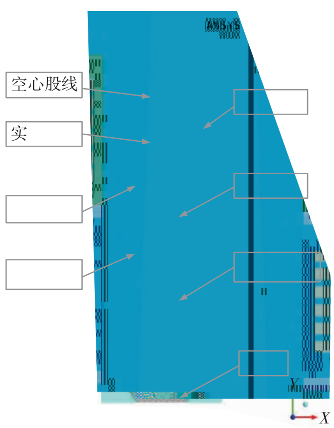
6

6

1 2

2. 3

7



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A PMBOK

PMBOK
F426 A 1001-9006 2021 04-0081-04

Project Management in Foreign Subcontracting Project

(Dongfang Electric Machinery Co. , Ltd. , 618000, Deyang, Sichuan, China)

Abstract: This article is based on the excitation system subcontracting project between DFEM and company A, in which, theory and management tools of project management in PMBOK and supply chain management are introduced in the execution of foreign subcontracting project to make sure the scope, schedule, quality of the product and service of the sub-contract project could fully satisfy the need of the main contract project.

Key

2021 – 09 – 24
1986 – 2009 2018

A

A 1

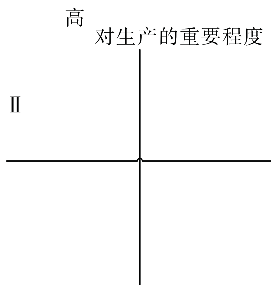
150 MW AP1000

A

NFF NFT

10%

1



3

3. 1

40

ɞ

NFF NFT A

A

A

A

2

	C		D
	C		D
	C		D
			D C
A		C	D

C D

5. 2

MIS

“ ”

41

1 . CANopen CAN D . 2008

2 . J . 2006 4 89 – 92

3 . CANopen DSP J . 2016 7 120 – 121

A

MIS

“ ”

1 . J . 2001 3 8 – 9 + 12

2 . K D . 2012

3 . M . 2000

4 . M . 2004

4 CANopen Device Profile and Motion Control. CiA Draft Standard Proposal402 S . Version 4. 02 2002

5 Copley Controls Corp. CANopen Programmer 's Manual S . Version 3 2006

6 . CANopen J . 2018 32 2 11 – 14

7 . CANopen J . 2020 33 1 72 – 74

611731

2021－09－24

1990－ 2012

CAREM ACP100

2010 2012

ACP100

2016

2017 “ ”

2019

36 2022

CAREM CNEA

2014

FCD 2019 11

Techint

2020 4 2022

1

	MW e
ACP100	100
CAP200	200
DHR	400 MWt
CAREM	30
RITM-200	50 × 2
ELENA	68 kWe
KARAT-45/100	45/100
RUTA-70	70 MWt
UNITHERM	6.6
VK-300	250
mPower	195 × 2
NuScale	50 × 12
SMR-160	160
W-SMR	225
DMS	300
IMR	350
SMART	100
UK-SMR	443

2 KLT-40S

RITM-200M ACPR50S KLT-40S

Afrikantov OKBM

2007 2017

2020 5 22

RITM-200M

Afrikantov OKBM KLT-40S

“ ” “ ” “ ”

6 RITM-200M “ ”

2

ACPR50S

2015 12

ACPR50S

“ ” ACPR50S

2016 9

11

“ ACPR50S ”

ACPR50S

2019 4

3

24 15

2022

2

	MW e
ACPR50S	60
ACP100S	100
KLT-40S	70
RITM-200M	50 × 2
ABV-6E	6 ~ 9
SHELF	6.4
VBER-300	325

3 HTR－PM

HTR-PM

2006

2

2006－2020 2012 12

FCD HTR-PM

2021

3

	MW e
HTR-PM	210
GTHTR300	300
GT-MHR	285
MHR-T	205.5 ×4
MHR-100	25 ~87
A-HTR-100	50
HTMR-100	35
PBMR-400	165
SC-HTGR	272
Xe-100	35

4 BREST-OD-300 SVBR-100 BREST-OD-300 Rosatom 2018 Glavgosexpertiza 2027 SVBR-100 AKME

Rostechnadzor 2015 AKME SVBR-100 2022

4

	MW e
BREST-OD-300	300
SVBR-100	100
4S	10
LFR-AS-200	200
LFR-TL-X	5 ~20
SEALER	3
EM2	265
SUPERSTAR	120
WLFR	450

5 IMSR IMSR Terrestrial Energy Terrestrial Energy 2017 6 CNL IMSR 11 CNSC IMSR 2018 12

20

5

	MW e	
IMSR	190	
CMSR	100 ~115	
CA Waste Burner	20	
ThorCon	250	
FUJI	200	
Stable Salt Reactor	37.5 ×8	
LFTR	250	
Mk1 PB-FHR	100	
MCSFR	50	&

eVinci 6 Westinghouse Electric Corporation

2024 2019 3 1 290 2022 eVinci

6

	MW e
eVinci	0.2 ~15

4

4.1 ——

[6-7]

120 5－6
30 2－3

4.2

Ux 2030
8.8 GWe 2040 22.1 GWe [8] Rolls-Royce 2035
5280
2050
25%

20

20
20 ~30
400 ~600
2050
200
2050

4% 8 ACP100
500 10
2050
16 GW 160 ACP100

5

“ ” 28

1 IAEA. Status of Small and Medium Sized Reactor Designs