接触网断线落在碳纤维车体的过电压仿真分析

徐 跃[1]，冯玉明[1]，白 刚[2]，王富强[2]，郭文卿[2]

(1. YD'L~ Ç å fD'D'D²5Í) 5K| ˜$ U•• H L~ Ç 266000U ž2. Y)*a |.ý ¬Kò ˜$ 0X 5 m 5-@/¢ I U••>« V Ë 030032)

摘 要U•电气化铁路运行环境的复杂性使接触网存在断线的可能，断开的接触网导线落在动车表面容易形成车体过电压。为了评估碳纤维动车车体由于导电性劣于传统铝合金车体而引起的过电压危害，基于某公司设计的半碳纤维半铝合金司机室车体结构，建立了动车组浪涌过电压电路模型。通过仿真求解接触网断线落在动车司机室车顶时司机室不同位置浪涌过电压的传输特性，得到车体过电压最大幅值 L 7 在 μs 内快速衰减，对车载电子设备造成安全隐患，并提出将车载设备的接地线缆直接连接在车厢的接地碳刷附近，为司机室车体的过电压防护设计提供理论依据。

关键词U•接触网断线；高速动车组；过电压

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4JNVMBUJPO BOBMZTJT PG PWFS WPMUBHF PG CPEZ PG ESJWFS T DBC

96 :VUF '&/(:VNJO #"* (BO 8"/('VRJBO 8FORJOH

33 2JOHEBP 4JGU 2JO $ HF BO 4IBO UP $JHF O B

5IF SE 3FTFBSDI *OTUJUVUF PG $IJOB &MFÐUSBOJD BO 4DBOPSMPGB (SPVQ $PSP

"CTUSBÐNQMFYJUZ PG UIF SBJMXBZ PQFSBUJPO FOWJSPONFOU NB MJOBFOE UIF CSPLFO DPOUBDU XJSF GBMMJOH PO UIF TVSGBDF PG UIF PG UIF DB*CO CPSEZS UP FWBMVBUF UIF PWFS WPMUBHF EBNBHF PG $B $'31 DBC CPEZ EVF UP JUT QPPSF DPOEVDUJWJUZ UIBO IJBU PG DJSDVJU NPEFM PG $'31 USBJO CPEZ JT FTUBCMJTIFE CBTFE PO UIF EFTJÐ USBOTNJTTJPO DIBSBDUFSJTUJDT PG TVSHF PWFSWPMUBHF TPMWFE CZ T5JNVMBYJUJNPVN WPMUBHF FOEF BD UFFO VBUFÇ XBJÐIJE MZ BJO QPUFOUJBM TBGFUZ IB[BSE GPS UIF JOCSPBOPBSTEF FFMUM BN FOFU HSPVOEJOH X FRVJQNFOU TIPVME CF DPOOFDUFE EJSFDUMZ XFJBDI QSP MSFVO BJO UIFPSFUJDBM CBTJT GPS UIF EFTJHO PG PWFSWPMUBHF QSPUFDUJPO

,FZXPSET CSPLFO DP;OUJ BDU OQBMJFFOP; VFSWJOP MUBHF

4 9J4IÎ J 4 Fý | Å w： U•Ü -ß3Ð4 9 4 | Å*]º £3P f Ò z6Ô5ì2' œ & åFû； !Fù ;0u'¥
S[1-2]U• < fP EK CD'D' •ûFù @ê@Í "+°Fù>- 3E5 | Å ÔD'3ð $ fÐJ 4FýD' •eE @ê@Íf· U•@ê@Í² v
-ß3Ð4 vJ 4FýD' •M· Ÿ $ fÐD' A '-ß3Ð4 9 4 | Å U•$ fÐ I TD'D² •…F 2 ùfJ 4Fý | Å -ß
3Ð4 9 4 | Å*]º3ð < å； < · 7¦0u Î>î 2L+° • ù U•¢Kg Ã¥ S D' •î œ：L4 Fý ŠD' •„ T . U•
Dó*a · T-ß3Ð4 D' •6+° L Ù =œ û'¥ S F ý*K B U•f Ê f-ß3Ð4 D'Cx (*a S U•T 9 4 | Å=" LŽ A 'J 4} U•
Ê f (*a S+° 8 " U•6)B£ *a-í {:i+° ˆ*T

ÔD'3ð CD' TP EKDü=x+°Dó/7 U•Ñ? 4} « ¸l S+° õ Ç ¸ • Ç U•?4}.ç3ë Ó*K+° ?4}*a S ö*a"m
+°& t À U•¹Ì 6MúL ¸S!@(Û ¯+°6|;¬ U•Ñ? 4}(3ëJ« K. ‹ U•f Ü f Ò 7Ky \ ，Æ/7 Ò " U•F ý*K Ù
3ë[3-5] Ñ? 4}Ù3ë：Ñ \ U• «¦A *a I,$ À Ç*a6î? ý Ð Ô ˆ U•ÙC ”C K$ U• Ç*a2'4 Y Ù U•líC =xD' Y

ÙU• %IíC　Í　　*a Í　　EF　0u@ê 3EL < 9 8/7 Ò+° ‹ ß　•ù　　　　　Ñ? 4} Ù3ë : V Ñ \　　U•¡ A　*a I　　Ð 9 ý *K Ô ˆ U•ÙC " VC K$ U• Ñ? 4}E　T Ç*a　U• (3ë Ø ºIíC 3ëC　6 å　　U• ÔD'3ð3ûDó " Y Ñ \D'M¢ (7 P ·- C　　U• TD' •="LŽ Ž <Dó*a ·　U•F %D'D©@ê 3+° µ " SEL <$ˆ TK¼ Ï

f ²ð \ Ñ? 4} Ù3ë9i T-ß3Ð4　$ f ÐD'M¢ "D' •Dó*a · %D'D©@ê 3+° µ " S　　U•X ³　ü ˜ $ ü &+° v-ß 3Ð4　vJ　4Fý $ f ÐD' • f î5/　　U•"wFû ¢ Ô (&-ß3Ð4 D' •+°Kg Ã î œ　U• &/÷ ² $ f ÐD' •Dó*a ·*aC　M ·　　U• EFDó +,K 2 ¼ ² Ñ? 4}　Ù3ë9i T-ß3Ð4　$ f ÐD'M¢ "D' •Dó*a ·+° LD¿ ¥ S　　U• f $ f ÐD' •+°Dó*a ·K^ Ð@ê @Í ü Ç ²)2@æ É š

1 动车组车体阻抗特性

A · ÔD' 2~7 #D' • f L4 J 4Fý | Å　　U•$ f Ð (1 ¸ 8 #)D' • f v-ß3Ð4　vJ 4Fý | Å　　D' • «D©3ÿ ° *] Á â　　Ó Å　D'M¢　0 Å3ð < f , V　•　　U•E Fø 2 û7®D' Î0u t f　　4 VLŽU-ûLŽ0u t f , V*aKg ¸*a K ^5€U• ® * 1 I.f　　$ f ÐD' 2 f-ß3Ð4　J 4Fý PF 2 U• ¢ Y R_{cfrp}, L_{cfrp} % À-ß3Ð4 F 2+° V = î œ　U• R'_{cfrp}, L'_{cfrp} % À-ß3Ð4 F 2+°3á = î œ U• R_{Al}, L_{Al} =".f J 4FýF 2+° V = î œ　　U•R'_{Al}, L'_{Al} =".fJ 4FýF 2+° 3á = î œ　　2~7 #D' Î f "D'J 4Fý | Å　　U•R_{hori}, L_{hori} % À V = î œ U•R_{vert}, L_{vert} % À3á = î œ　　D'D' Á " F fJ 4Fý | Å　　U•R_{joint} =".fD'K E　Ñ "
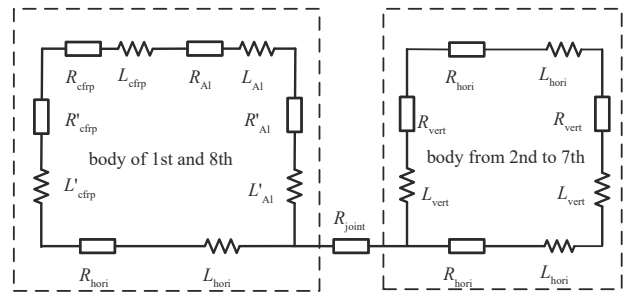

Fig.1 Circuit model of Electric Multiple Units(EMU) body
* 1 D' •*aC　M ·

% º 2~7 D'+°J 4FýD' •　U•K1 ³(Z [6–7]　- D' • V =*aKg f　　12.8 mΩU•*a K f　5.78 µHU•3á =*aKg f 2.8 mΩU•*a K f　0.61 µH　% º 1 ¸ 8 D'+° $ f ÐD' •　U•J 4Fý -ß3Ð4 | Å 0 Œ , v　　e š (•*aKg@Í0Ã ˜ ; $R=\rho l/S$U• ¢ Y R f*aKg U•ρ　l　S 2 W % À | Å+°*aKg(³　J « Ò ¸ V VLŽ/　U•$ f ÐD' •J 4FýF 2 V =J« Ò f Ë '+° , v　U• ¢ î œ 9　　U•E @Ð f V =*aKg　f Ë '+° , v　　U•Ÿ 6.4 mΩUžî5/ Ÿ, (3ë*a K@Í0Ã ˜ ;　　U•

$$L=\frac{\mu_0 l}{2\pi}(\ln\frac{2l}{r}-0.75) \tag{1}$$

; Y U•μ_0 f,K/!-í ((³　　Užl　r f | Å+°J « Ò ¸ VLŽ v °　U• • (3ëJ « ÒE　S º VLŽ v ° "　U•J« Òl4U- f Ë '+° , v U• % œM¥　B ´; U• Dý h@Ð f*a KFû　f Ë '+° , v　　U•š • Ô Ù $ f ÐJ 4FýD' •F 2 V =*a K3Ò f Ë ' +° , v　U•Ÿ 2.89 µH　3á = î œ 9 ý*K　B

-ß3Ð4　À*T | Å g>- 1　*] • =4B3ó / 4 <+°J& n å ; 2 W f　　[O]l0　[0/90/0/90/0]s　[0/90/45/−45/0]s+° 3 .ù n 4 «　*] Ð õ4B3ó /, Ñ 4 <+° n 4 «　　¢ Y U•[O]l0 f , J& n>þ Ò+° • =J& n n 4 «　　U•[0/90/0/90/0]s f W 2 .ù>þ Ò+° • ÐJ& n n 4 «　U•[0/90/45/−45/0]s f 1　　4 .ù>þ Ò+° π/4 J& n n 4 «　U•58 Ð õ4B3ó n 4 «*] Ð õ4B3ó / ，Ñ 4 <　U• 9 „TJ& n>þ Ò　J& nM¦ »+°K MÄ [1–2]　　D' •-ß3Ð4 | Å FFó*T*] È3å4B3ó /, Ñ 4 <+°-ß3Ð4 n 4 « U•　f $ f　50 mm×50 mm×2 mm+° c " U•!ë • Ð å =E =xKg Ã"wA　U• Ã \ È3å4B3ó+°-ß3Ð4 n 4 «!ë • Ð å =+°Kg Ã 2 /! D¯ s，　U•*aKg(³ S3Ò f 450 Ω·mm²/mU•*a K3Ò f 0.18 µH　582WJ +°*aKg(³ f 0.018 Ω·mm²/mU• J 4} 9 4 T-ß3Ð4 | Å+°="LŽ　U• >ò f ¢5€　U•*]ºJ +° (*a SE f º-ß3Ð4 | Å　　U•I　9 4 | Å+°Kg Ã î œ *TJ 4}+°Kg Ã î œ +　　J 4}>ð h f　200，(û Ÿ å8 $0‡4} 6+° €,h œ, f　200)U• Æ Ò f 0.1 mmU•D'J 4Fý | Å f ·-6€3ÿ °　U•9À+Ú Æ Ò3Òð f mm(6 7 2 n 0 3 mm)　E5　Æ Ò 2 W f 0.2 mm　6 mm　　¢ f $,$ 8+°J 4} c "，J 4Fý c "E =xKg Ã"wA　　U• Ã \J 4}*aKg3Ò fJ 4Fý+°　300 9 U•*a K3Ò fJ 4Fý «+° 1.2 9　š • \ 0Ã-ß3Ð4 UJ 4} U0D' •+°*aKg3Ò fJ 4FýD' •+°　20 9 U•*a K fJ 4FýD' •+°　1/4　*] • Ã \ $ f ÐD'J 4Fý F 2 V =*aKg3Ò f　6.4 mΩU•*a K3Ò f 2.89 µHU•3á =*aKg3Ò f2.8 mΩU•*a K3Ò f 0.61 µHUž-ß3Ð4 F 2 V =*aKg 3Ò f 1.92 ΩU•*a K3Ò f 3.47 µHU•3á =*aKg3Ò f840 mΩU•*a K3Ò f 0.73 µH

2 仿真模型构建

& º ÔD'3ð g*aC 3ÿ °　U•*3ÿ 4 ÊKqD' • | Å1§ ·　　Ç*a3ëC Kg Ã　D' ±@ê 3 · #0u U• % ÔD'3ð3ÿ °E =x*a C î œ0u t　ÔD'3ðDó*a · M ·*] Ç*a2'4　¸ ÔD'3ð PF 23ð <　　Ç*a2'4 *]¡ A　*a I　　N´3ë　Ñ? 4}　ÍÎ D" "m3ë3ð <　'¡ A　*a I Ç*a*a ·　U_S f 27.5 kV　5/;}0¬ •J* · Ø .，Ñ Ç*a å ;+° •3ë*a!@ BIíC '¡ A

4}U• & º Carson)2@֊[6-7]U•0u t*aKg R_S　*a K L_S　% *a å C_S 2 W f 3.4 Ω　0.034 1 mH ¸ 0.283 μF　　ÔD'3ð M·
1 P ·*a42　　D'D© Ô Ç2'4　D' Î ¸ Ñ \2'4　　　P ·*a42 · # f　TENAX–Train–PluxU• *a ? \ g ÙC ” wK
P ·*a42J« Ò3Ò f 2 mU•P ·*a42J&@ê T3 ¸ 6 D'U• ¢ Y 3D' ¸ 6 D'+°P ·*a42J« 20 mU•4D' ¸ 5 D'+°P ·*a42J«
26 m　• yJ« Ò*a42+°*aKg　*a K　*a å 2 W f 0.2 mΩ/m　0.17 μH/m ¸ 0.32 μF/m　'¡ A g　· ”Fó*T　XFRM–
Linear 3ë S　· ”　U• · ” ¸ M Ó*a K f　　0.34 HU• ¸ M Ó*a K f　62.09 HU• 95/;}P z · Ó4 3ð*aKg　　"m ” g
>- 1　"m M ƒ¸E2　M ƒ　U•*]4 4D 1 ø - · ¢ •0Í7Û's　　(Insulated Gate Bipolar TransistorU•IGBT) ¸ -0Í3ð 4
58 <U• % ºD' •Dó*a · Ó*K　: j • ù　　U• · %A F 2)*‘　　9@Í　K1 ³(Z [6-7] - 　U• • VBKD©*a Ô fMÉ Æ Ë(³
f 600 kWU•û　g　· ”f　　8 VBKD©*a f ü Ç*a6)U•g Ë(³ f　4 800 kWU•3û@Í0Ã　ÃU• · ”BKD©0u t*aKg R_m f
0.71 Ω　A · ÔD'Fó*T ^5€*aKg ”+° Ñ \ å ;　U•Ñ *a Kg μ=ñ TD' Î+° • 7 å　U•*aKg h f 50 mΩU•&b :*] Ñ *a42
2 WE Ñ TD' Á y :+°　2 VD¯ = âD 0　U•0u t*aKg ¸*a K 2 W f　2.4 mΩ ¸ 2.04 μH　• B U• Ñ \-ß c 0+°*aKg3Ò f
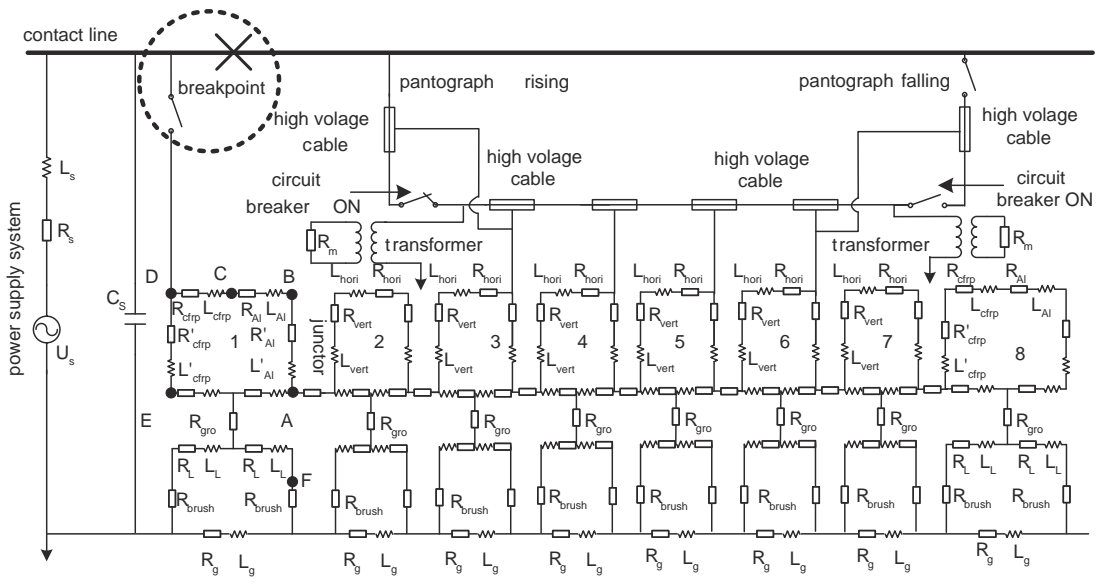5.03 mΩ　š • Ã \ ÔD'3ðDó*a · +,K M · ® *　2 l.f

Fig.2 Surge overvoltage circuit model of EMU body
* 2　ÔD'3ðDó*a · +,K M·

　;†3ë 2 4F 2=".f Ñ? 4} T Ù%å 0 Ù, 　U•&b :9i T $ f Ð　(1 #D') D'M¢-ß3Ð4 , Ó(D %å　 M · Y+° A　B
C　D　E %å f*a · Îl'+° y4š　U• 2 W=".fD' ÁJ 4Fý, Ó　　D'M¢J 4Fý, Ó　J 4Fý ÿ ÿ-ß3Ð4 *xLŽ　D'M¢-ß
3Ð4 , Ó　D' Á-ß3Ð4 , Ó ¸ :Dš Ñ \-ß c

3　仿真结果分析

　X ³Fó*T OrCAD/PSPice +,KD› "E =xDó*a · +,K 2 ¼　U• ® * 3 l.f　　A D› " ?K *T º*a |*aC +,K@ê@Í 2
¼U•*xLŽ Ð ¾ S ©U•3ÿ È ò-š U• £ 5D¯P +° î5/ # h　　TD› " Y &/÷ ÔD'3ð"–¸Dó*a · M·　U•@ê4š Ç*a*a#¼ f
27.5 kV+° M½ • R" 　U• Ñ? 4}9i T $ f ÐD'M¢,ØK 4} ·,$ y>þ f　　90°U•D' · 9 8 y4š"–¸Dó*a · +,K3ÿ È ® 7
　Ñ? 4} (3ë Y Ñ \-ß3Ð4 D' • :　U•D'M¢-ß3Ð4 , Ó*a y,ØK sP U•,P *a yDê \ ²　26 kV　9 8 y4š+°"–
"¸Dó*a · BB· ë & X ,7　U• T 60 μs ± EK=œ ûU• w: T ;8/　±" Ô　　D' ÁJ 4Fý, ÓDó*a · q h f　6 kVUž
D' Á-ß3Ð4 , ÓDó*a · q h f　23 kVUžJ 4Fý ÿ-ß3Ð4 *xLŽ 0 U•Dó*a ·, S q hDê \ ²　20 kV　Ñ \-ß c 0Dó*a
· q h! D¯ ;　U• f 34 V
　Dó*a · T V = L ÙDó/7 Y　U• úD'M¢-ß3Ð4 , Ó \J 4Fý-ß3Ð4 *xLŽ U•, S q h 7Ky ²　6 kV• úJ 4Fý-ß3Ð
4 *xLŽ \D'M¢J 4Fý, Ó　U•, S q h 7Ky ²　8 kVU• $ f ÐD' • ”J«　26 mU•J 4FýF 2 ¸-ß3Ð4 F 2F) [　13 mU•
•Dó*a · T-ß3Ð4 D' •=”LŽ V = LD¿Dó/7 Y　U•*a · 7Ky q Ò f　461.5 V/mU•Dó*a · TJ 4FýD' •=”LŽ V = LD¿
Dó/7 YU•*a · 7Ky q Ò f　615.4 V/m　Dó*a · T3á = L ÙDó/7 Y U• ú-ß3Ð4 , Ó+°D'M¢ \D' Á　U•, S q h 7Ky ²
3 kVU• úJ 4Fý, Ó+°D'M¢ \D' Á　U•, S q h 7Ky ²　6 kV　ÔD'D' ÎP Ò3Ò f　4 mU• •Dó*a · T-ß3Ð4 , Ó!ë
3á = L ÙU•, S*a · 7Ky q Ò f　750 V/mU• TJ 4Fý, Ó!ë3á = L Ù　U•, S*a · 7Ky q Ò f　1.5 kV/m　Dó*a ·!ë

3á = L Ù=œ û q Ò ⁰V = L Ù U• TJ 4Fý="LŽ L Ù+°=œ û q Ò ⁰-ß3Ð4 ="LŽ

Fig.3 Over–voltage of broken contact line falling on the body of driver's cab
* 3 Ñ? 4} Ù3ë9i T $ f ÐD' •+°Dó*a · +,K" Ž

Ií 3 TB/T3021–2001 ' IíE• fD'D'D²*a |=ñ4š (Y0X12.2.6 •>ð Æ[8]U•D'D©*a |@ê 3 I6) « +°, S"–",Dó *a · f 2 kVU•I A · ÔD' $ f Ð ±*a |@ê 3 Ñ \%å E Ñ T Ñ \-ß c 0

4 结论

EFDó 2 ¼ ¸"wA -ß3Ð4 | Å ¸J 4}+°Kg Ã'¥ S U• Ô (&-ß3Ð4 D' •+°Kg Ã î œ U• &/÷ ² $ f ÐD' •Dó*a · *aC M · U•EFDó +,K 2 ¼ ² Ñ? 4} Ù3ë9i T-ß3Ð4 $ f ÐD'M¢ "D' •Dó*a ·+° LD¿'¥ S U• £ •3ÿ@æ ® 7U•

1) -ß3Ð4 D' •+° (*a S g>- ÉB, B n+°J 4} U•J 4} T Ê f (*a S+° 8 " U• ‹6)B£ *a-í {:i+° ˆ*T

2) Ñ? 4} Ù3ë9i T $ f ÐD' • F (7 D' •*a y,ØK sP U•, S*a ·Dê \ ² 26 kVU•] ⁰ Ñ? 4} % *a å D' •*a K ¸*aKg+° „ T U•Dó*a · ý*K [8• ¢ T 60 µs ± EK=œ û

3) $ f ÐD' •Dó*a ·!ë3á = L Ù=œ û q Ò ⁰V = L Ù U• TJ 4Fý="LŽ L Ù+°=œ û q Ò ⁰-ß3Ð4 ="LŽ

4) D' •Dó*a · S ⁰ 2 kVU• 9$ BßD'D©*a |@ê 3 µ " \+° Ñ ' 3 ò U•:Dš Ñ \-ß c 0Dó*a · , S h 5 34 VU•

ˆ fD'D©*a |@ê 3 µ ” \+°E Ñ%å

参考文献：

[ ] DH(·IÓ -ß3Ð4 (*a 9 4|Å+°-@/¢ :À*T [‡ (ç)⁻IÎ 9 4|Å -*6 %RO H + VQ3FTFBSDI BOE BQQMJDBUJPO PG DBSCPO GJCF$‡S'FCFS P3SFDJ OG PPSDO PEFEV DUM.BW JJDDPN SQPNQ FT JTTO KJTTO

[ ] z- F oJ7 -ß3Ð4 9 4|ÅT7VUM² +°À*T [‡ Y)u' -* 8F.$0 2VBOG GQM JDBUJPO F DBSCPO GJCF DPNQPTJUFT$THOFDFTTNQ OBVUJD GPMLT KJTTO

[ ] ...#(IíC Ñ? 4}d>í Ù3ë · q öM°K^ Ö é-@/¢ [‡ Y)@ê3 /7 46/ .MBR3FTFBSDI PO DPNN BDDJEFOUT BOE QSFWFOUJWF NFBT‡V SSFJ POBG P.MBS PLUF &OH'BJJOMFXFZBSE EBUPK P4U6BDU MJO 4#(-

[ ] (·, IíC Ñ? 4}d>í Ù3ë · q :M°K^0,*' Î/¢ [‡ &0}¬ [,ý 8"/(1B03FTFBSDI PO DPNN BDDJEFOUT BOE QSFWFOUJWF TTS‡B‡U B#N Z MPEGJ OOFS5EFPOOSP BMPMHXB Z%FDWP FOU BO NFJ‡UUD EP¢$J/,*4 6/+;,'

[ ] 7ûL L;½ &º 3ë L K}4 +°P EKIíC +ý"w2'4 [‡ VB— ¥.ý' :*a| ›'Ñ 46 9VF ;)"/(9JBPY)WJOHTQFFE SBJMXBZ NPOJUPSJOH TZTUFF‡N G BV SDBPPO PXG JS5FFMFSTBT FTUF[O4 &MFDUSPOJD *OGPSNBUJPO 5FD$EOOPQJMMPH[Z,:%"

[ ] L9Dê ÔD'3ð sKy ?D' •"—",Dó*a · 2 /-@/¢ [% <F) >« ƒ ÐEF S')60 %B4UVEZ PO TVSHF PWF EJTUSJCVUCJPOEZ PDGB VDBSEF CZ QBOUPHSBQI[$SBJ JSTFO I4E‡BOTP VEUSJXG QUO+JUP PGU R U6OÇ E‡BJ,*$%.%

[ ] Kt,(P EK ÔD'3ð sKy ?® -Dó*a · Ž< f)2 : ½ bå" -@/¢ [% <F) >« ƒ ÐEF S' $)&/ 1B4UVEZ PO UIF PWFSWPMUBHF NFDIBOJTN BOE TVQQSFTTJOH NFUIPE JO UTQ‡QRFSTFBTJ PO$IFOH‡EJVO4PVUIXFTU +JBPUPOH 6OJWFSTJUZ

[ ] Y))â 3 ò B0Í)2 „F D"E• ÐEF fD'D'D²*a |=ñ4š (# 5 [‡ C Ø Y)3 ò &'t.j 4UBOEBSEJ[BUJPO "ENJOJTUSBUJPO PG3BJMXBZ Z FB P‡OFMOGFFJDDUUSBPUPOVOC JSMB JVFG N#FJI OOB WFIJ‡$#M5 T [‡ #FJK4JOBH EBST 1SFTT PG $IJOB

作者简介：

徐 跃(1979−)U•*c U•† U• ... ´3ÓP 3Ó /7 4 U• g >--@/¢ å = f*a!@ 2'4 Kò <@ê@Í *a-í ¨ å .emailU• xuyue@cqsf.com.

冯玉明(1987−)U•*c U•-• U•P 3Ó /7 4 U• g >--@/¢ å = f*a-í ¨ å ¸LŠ Ñ? Ç*a2'4 @ê@Í .

白 刚(1993−)U•*c U•-• U• /7 4 U• g >--@/¢ å = f*aC @ê@Í *a-í ¨ å .

王富强(1980−)U•*c U•-• U•P 3Ó /7 4 U• g >--@/¢ å = f 9 4|Å¬ [*a-íK^ Ð ¬[.

郭文卿(1985−)U•*c U•' U•P 3Ó /7 4 U• g >--@/¢ å = f2' 3Ó*a-í ¨ å :K^ Ð .