

	10	20	30	40	50	60	70	80	90	100		
	← 60 →											
SM98/Korea/KJ857455	M	R	S	L	T	F	P	L	L	P	L	
DR13/Korea/JQ023161	F	L	I						D	G		
DR13-V/Korea/DQ462404	T	P	F	L	I				D	G		
DR13/Korea/DQ862099	F	L	I						D	G		
CV777/CN/KT323979	T	P	F	L	I				D	G		
AJ1102/CN/JX188454	K	T	F	S	SAN			IGE-NQGVN.T	AGQHP	H	RGGH	
France/2014/KR011756	K	N	F	S	I				L		G	
CV777/Belgium/AF353511	F	L	I						L		G	
Belgium/2015/KR003452	K	N	F	S	I				L		G	
GER/2014/LM645057	K	N	F	S	I				L		G	
USA/2013/KF468753	K	T	F	S	SAN			IGE-NQGVN.T	AGQHP	V	H	RGGH
USA/2014/KJ399978	K	N	F	S	I				L		G	
USA/2014/KR265813	K	T	F	S	SAN			IGE-NQGVN.T	AGQHP	V	H	RGGH
Mexico/2014/KJ645700	K	T	F	S	F	SAN		IGE-NQGVN.T	AGQHP	V	H	RGGH
Korea/2002/AF500215	S	Y	SAR					GETQGG-APR	AGRH	H	RGGH	
Korea/2008/GU180142	L	FV	Y	SAN				GETQAG-RP	AGRHP	H	RGGH	
Korea/2008/JN184635	K	T	F	A	S	A	SAN	H	TGE-NHGVN.T	AGQHP	H	RGGH
Korea/2009/GU180144	T	F	I	Y	SAN			GETQAG-RP	AGRHP	H	RGGH	
Korea/2010/GU937797												
Korea/2011/KC879280	L	FV	H	SAN				IGE-NQGVN.T	AGQHP	H	RGGH	
Korea/2012/KC879281	L	FV	H	SAN				IGE-NQGVN.T	AGQHP	H	RGGH	
Korea/2012/KJ857475	K	T	F	S	SAN			IGE-NQGVN.T	AGQHP	V	H	RGGH
Korea/2013/KJ451037	T	F	I	N	SAV	Q		GE-KQVDAPR	AGRVD	V	H	RGGH
Korea/2013/KJ451045	T	F	S	SAN				IGE-NQGVN.T	AGQHP	V	H	RGGH
Korea/2014/KJ451047	T	F	S	SAN				IGE-NQGVN.T	AGQHP	V	H	RGGH
Korea/2014/RM403155	N	F	S	I					L		G	
Taiwan/2014/KP276250	K	T	F	S	SAK			IGE-NQGVN.T	AGQHP	V	H	RGGH
CN/2004/AY653204	K	T	S	I					L		G	
CN/2006/DQ985739	K	T	F	FS	I				L		G	
CN/2010/JX501318	K	N	F	L	S	I			L		G	
CN/2011/JQ638920	K	T	F	S	SAN			IGE-NQGVN.T	AGQHP	V	H	RGGH
CN/2011/JN825712	K	T	F	S	SAN			IGE-NQGVN.T	AGQHP	V	H	RGGH
CN/2012/KC210145	K	T	F	S	SAN			IGE-NQGVN.T	AGQHP	V	H	RGGH
CN/2012/JX112709	K	T	F	S	SAN			IGE-NQGVN.T	AGQHP	H	RGGH	
CN/2013/KF761675	K	T	F	S	SAN			IGE-NQGVN.T	AGQHP	H	RGGH	
JPN/2013/LC063836	K	T	F	S	SAN			IGE-NQGVN.T	AGQHP	V	H	RGGH
JPN/2014/LC063845	K	N	F	S	I				L		G	
KH/Japan/AB548622	KF	F	S	SAK	V			GEQQNGSAPP	AGTHTP	H	RGGH	
NK/Japan/AB548623	K	F	D	RAK	L			GEQQDGSAPR	GQH	H	RGGH	
Thailand/2008/KC764953	L	FV	SAN					IGE-NQGVN.T	AGQHP	H	RGGH	
Thailand/2008/KC764952	L	FV	SAN					IGE-NQGVN.T	AGQHP	H	RGGH	
Thailand/2010/KC764955	L	FV	SAN					IGE-NQGVN.T	AGQHP	H	RGGH	
Thailand/2011/KC764959	H	S	SAN					IGE-NQGVN.T	AGQHP	H	RGGH	
Thailand/2012/KC764958	H	S	SAN					IGE-NQGVN.T	AGQHP	H	RGGH	
Thailand/2013/KF724938	S	SAN						IGE-NQGVN.T	AGQHP	H	RGGH	
Thailand/KF724938	L	FV	SAN					IGE-NQGVN.T	AGQHP	H	RGGH	
HUA PED45/VN/KP455313	K	T	W	F	S	SAN		IGE-NQGVN.T	C	AGQHP	H	RGGH
HUA PED47/VN/KP455314	K	T	W	F	S	SAN		IGE-NQGVN.T	AGQHP	H	RGGH	
HUA PED67/VN/KP455319	K	T	F	S	I				L		G	
HUA PED96/VN/KT941120	KF	T	F	S	G	SAK		IGE-NYGVN.T	AGQHP	V	H	RGGH
JFP/VN/KJ960178	K	T	F	S	SAN			IGE-NQGVN.T	AGQHP	H	RGGH	
VAP/VN/KJ960179	K	T	F	S	SAN			IGE-NQGVN.T	AGQHP	H	RGGH	
KCHY/VN/KJ960180	K	T	F	S	SAN			IGE-NQGVN.T	AGQHP	H	RGGH	
IBT/VN/2018	K	T	F	S	SAN			IGE-NQGVN.T	AGQHP	H	RGGH	



210      220      230      240      250      260      270      280      290      300

↓


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SM98/Korea/KJ857455 TRCNRRRSCAMQVVYTPFYMLNVTSAAGEDGIYVEPCTANCTGYAANVFATDSNGHIPECFSEFNNWFLLSNDSTLLHGKVVSNQPLLVNCLLAI PKIYGL
DR13/Korea/JQ023161 . . . . . K . . . . . S . . . . . G . . . . .
DR13-V/Korea/DQ462404 . . . . . K . . . . . S . . . . . G . . . . . W . . . . .
DR13/Korea/DQ862099 . . . . . K . . . . . S . . . . . G . . . . . W . . . . .
CV777/CN/KT323979 . . . . . K . . . . . S . . . . . G . . . . . W . . . . .
AJ1102/CN/JX188454 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
France/2014/KR011756 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
CV777/Belgium/AF353511 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
Belgium/2015/KR003452 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
GER/2014/LM645057 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
USA/2013/KF468753 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
USA/2014/KJ399978 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
USA/2014/KR265813 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . . S . . .
Mexico/2014/KJ645700 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
Korea/2002/AF500215 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
Korea/2008/GU180142 . . . . . N . . . SGG . . . A . . . E . . . I . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
Korea/2008/JN184635 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
Korea/2009/GU180144 . . . . . N . . . SGG . . . A . . . E . . . I . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
Korea/2010/GU937797 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
Korea/2011/KC879280 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
Korea/2012/KC879281 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
Korea/2012/KJ857475 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
Korea/2013/KJ451037 . . . . . SK . . . SGG . . . K . . . I . . . V . . . S . . . QL . . . I . . . EP . . . G . . . V . . . W . . .
Korea/2013/KJ451045 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
Korea/2014/KJ451047 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
Korea/2014/KM403155 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
Taiwan/2014/KP276250 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
CN/2004/AY653204 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
CN/2006/DQ985739 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
CN/2010/JX501318 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
CN/2011/JQ638920 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
CN/2011/JN825712 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
CN/2012/KC210145 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
CN/2012/JX112709 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
CN/2013/KF761675 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
JPN/2013/LC063836 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
JPN/2014/LC063845 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
KH/Japan/AB548622 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . . I . . .
NK/Japan/AB548623 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
Thailand/2008/KC764953 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
Thailand/2008/KC764952 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
Thailand/2010/KC764955 . . . . . K . . . SGG . . . G . . . S . . . QH . . . I . . . EP . . . G . . . V . . . W . . . H . . .
Thailand/2011/KC764955 . . . . . K . . . SGG . . . E . . . S . . . Q . . . SD . . . S . . . DG . . . G . . . V . . . W . . .
Thailand/2012/KC764958 . . . . . K . . . SGG . . . E . . . S . . . Q . . . SD . . . S . . . DG . . . G . . . V . . . W . . .
Thailand/2013/KF724938 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
Thailand/KF724938 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . .
HUA PED45/VN/KP455313 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . . T . . .
HUA PED47/VN/KP455314 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . . M . . . T . . .
HUA PED67/VN/KP455319 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . . M . . .
HUA PED96/VN/KT941120 . . . . . K . . . SGG . . . E . . . S . . . G . . . S . . . QL . . . I . . . S . . . QP . . . G . . . V . . . W . . . M . . .
JFP/VN/KJ960178 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . . M . . .
VAP/VN/KJ960179 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . . M . . .
KCHY/VN/KJ960180 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . . M . . .
IBT/VN/2018 . . . . . K . . . SGG . . . E . . . S . . . Q . . . I . . . EP . . . G . . . V . . . W . . . M . . .

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510
520
530
540
550
560
570
580
590
600

SM98/Korea/KJ857455 SHEQPISEFVTLPLFNDHSFVNITVSAAFGGLSSANLVASDITTINGPSSFCVDTRQPTITLTFYVNVNSYGVVSKSQDSNCPFTLQSLVNDYLSFSKFCVSTS  
 DR13/Korea/JQ023161 .....S.....H.G...I.....  
 DR13-V/Korea/DQ462404 .....S.....H.G...I.....  
 DR13/Korea/DQ862099 .....S.....H.G...I.....  
 CV777/CN/KT323979 .....S.....H.G...I.....  
 AJ1102/CN/JX188454 .....T.....S.....H.G...I.....S.....  
 France/2014/KR011756 .....S.....S.....H.G...I.....S.....  
 CV777/Belgium/AF353511 .....S.....S.....H.G...I.....S.....  
 Belgium/2015/KR003452 .....S.....S.....H.G...I.....S.....N.....  
 GER/2014/LM645057 .....S.....S.....H.G...I.....S.....  
 USA/2013/KF468753 .....S.....S.....H.G...I.....S.....  
 USA/2014/KJ399978 .....S.....S.....H.G...I.....S.....  
 USA/2014/KR265813 .....S.....S.....H.G...I.....S.....  
 Mexico/2014/KJ645700 .....S.....S.....H.G...I.....S.....  
 Korea/2002/AF500215 .....S.....DSGG.....R.....S.....  
 Korea/2008/GU180142 .....S.....DSGG.....R.....  
 Korea/2008/JN184635 .....S.....S.....H.G...I.....VS.....  
 Korea/2009/GU180144 .....S.....DSGG.....R.....  
 Korea/2010/GU937797 .....S.....S.....H.G...I.....R.....  
 Korea/2011/KC879280 .....T.....S.....S.....DH.G...I.....R.....  
 Korea/2012/KC879281 .....T.....S.....S.....DH.G...P.....R.....  
 Korea/2012/KJ857475 .....S.....S.....S.....H.G...I.....S.....  
 Korea/2013/KJ451037 .....S.....S.....DH.G...I.....G.....S.....I.....N.....  
 Korea/2013/KJ451045 .....S.....S.....H.G...I.....S.....  
 Korea/2014/KJ451047 .....S.....S.....H.G...I.....S.....  
 Korea/2014/KM403155 .....S.....S.....H.G...I.....S.....  
 Taiwan/2014/KP276250 .....S.....S.....H.G...I.....S.....  
 CN/2004/AY653204 .....S.....S.....H.G...I.....S.....  
 CN/2006/DQ985739 .....S.....S.....H.G...I.....S.....  
 CN/2010/JX501318 .....S.....S.....H.G...I.....S.....  
 CN/2011/JQ638920 .....T.....S.....S.....H.G...I.....S.....N.....  
 CN/2011/JN825712 .....S.....S.....S.....G...I.....S.....  
 CN/2012/KC210145 .....S.....S.....S.....H.G...I.....S.....N.....  
 CN/2012/JX112709 .....T.....S.....S.....H.G...I.....S.....  
 CN/2013/KF761675 .....Y.....T.....S.....S.....H.G...I.....S.....  
 JPN/2013/LC063836 .....S.....S.....S.....H.G...I.....S.....  
 JPN/2014/LC063845 .....S.....S.....S.....H.G...I.....S.....  
 KH/Japan/AB548622 .....S.....S.....H.GG...I.....R.....I.....N.....S.....  
 NK/Japan/AB548623 .....S.....S.....DSGG.....H.....  
 Thailand/2008/KC764953 .....S.....S.....S.....H.G...I.....S.....  
 Thailand/2008/KC764952 .....S.....S.....S.....H.G...I.....S.....C.....  
 Thailand/2010/KC764955 .....S.....S.....S.....H.G...I.....S.....G.....  
 Thailand/2011/KC764959 .....S.....S.....S.....H.G...I.....S.....  
 Thailand/2012/KC764958 .....S.....S.....S.....H.G...I.....S.....  
 Thailand/2013/KF724938 .....S.....S.....Y.G...I.....S.....  
 Thailand/KF724938 .....S.....S.....S.....H.G...I.....S.....  
 HUA PED45/VN/KP455313 .....T.....S.....S.....DH.G...I.....S.....  
 HUA PED47/VN/KP455314 .....T.....S.....S.....DH.G...I.....S.....  
 HUA PED67/VN/KP455319 .....S.....S.....S.....H.G...I.....S.....  
 HUA PED96/VN/KT941120 .....T.....S.....S.....P.G...I.....S.....A.....  
 JFP/VN/KJ960178 .....T.....S.....K.....HRG...I.....R.....SR.....PT.....G.....G.....  
 VAP/VN/KJ960179 .....T.....S.....S.....H.G...I.....W.....S.....S.....PT.....  
 KCHY/VN/KJ960180 .....T.....S.....S.....H.G...I.....W.....S.....S.....PT.....  
 IBT/VN/2018 .....IY.....T.....S.....S.....H.G...I.....S.....

	610	620	630	640	650	660	670	680	690	700
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
SM98/Korea/KJ857455	LLAGACTIDLFGYPAFGS---	GVKLTSLYFQF	KGBELTCTGPKPLEG	ITDVSFMTLDVCTK	YTYGFKGEG	ITTLTNS	SLAGVYVYTSNS	GGQLLAF	KNV	
DR13/Korea/JQ023161	.....	E.....	F.....	.....	V.....	.....	F.....	D.....		
DR13-V/Korea/DQ462404	.....	E.....	F.....	S.....	Q.V.....	.....	F.....	D.....		
DR13/Korea/DQ862099	.....	.....	.....	.....	.....	.....	.....	D.....		
CV777/CN/KT323979	.....	E.....	F.....	.....	Q.V.....	.....	F.....	D.....		
AJ1102/CN/JX188454	.....	S.....	E.....	F.....	.....	V.....	F.....	F.....	D.....	
France/2014/KR011756	.....	S.....	E.....	F.....	.....	V.....	F.....	D.....		
CV777/Belgium/AF353511	.....	.....	.....	.....	.....	.....	.....	D.....		
Belgium/2015/KR003452	.....	SG.....	E.....	F.....	.....	V.....	F.....	D.....		
GER/2014/LM645057	.....	S.....	E.....	F.....	.....	V.....	F.....	D.....		
USA/2013/KF468753	.....	S.....	E.....	F.....	.....	V.....	F.....	D.....		
USA/2014/KJ399978	.....	S.....	E.....	F.....	.....	V.....	F.....	D.....		
USA/2014/KR265813	.....	S.....	E.....	F.....	.....	V.....	F.....	D.....		
Mexico/2014/KJ645700	.....	S.....	E.....	F.....	.....	V.....	F.....	D.....		
Korea/2002/AF500215	.....	.....	.....	.....	.....	V.....	F.....	D.....		
Korea/2008/GU180142	.....	.....	.....	.....	.....	Q.V.....	F.....	D.....		
Korea/2008/JN184635	.....	S.....	H.D.....	D.....	F.....	.....	F.....	D.....		
Korea/2009/GU180144	.....	.....	.....	.....	.....	Q.V.....	F.....	D.....		
Korea/2010/GU937797	.....	.....	.....	.....	.....	.....	.....	D.....		
Korea/2011/KC879280	.....	SS.....	D.....	F.....	E.....	.....	V.....	F.....	D.....	
Korea/2012/KC879281	.....	SS.....	D.....	F.....	E.....	.....	V.....	F.....	D.....	
Korea/2012/KJ857475	.....	S.....	E.....	F.....	E.....	.....	V.....	F.....	I.....	D.....
Korea/2013/KJ451037	.....	S.....	.....	.....	.....	V.....	F.....	F.....	D.....	
Korea/2013/KJ451045	.....	S.....	E.....	F.....	.....	V.....	F.....	D.....		
Korea/2014/KJ451047	.....	S.....	E.....	F.....	.....	V.....	F.....	D.....		
Korea/2014/KM403155	.....	S.....	E.....	F.....	.....	V.....	F.....	D.....		
Taiwan/2014/KP276250	.....	S.....	E.....	F.....	.....	V.....	F.....	D.....	P.....	
CN/2004/AY653204	.....	S.....	E.....	F.....	E.....	.....	V.....	F.....	D.....	L.....
CN/2006/DQ985739	.....	S.....	E.....	F.....	.....	V.....	F.....	D.....		
CN/2010/JX501318	.....	S.....	E.....	F.....	.....	V.....	S.....	F.....	H.....	D.....
CN/2011/JQ638920	.....	S.....	E.....	F.....	.....	V.....	.....	F.....	H.....	D.....
CN/2011/JN825712	.....	S.....	E.....	F.....	.....	V.....	.....	F.....	F.....	D.....
CN/2012/KC210145	.....	S.....	D.....	F.....	.....	V.....	.....	F.....	D.....	
CN/2012/JX112709	.....	S.....	E.....	F.....	.....	V.....	.....	F.....	D.....	
CN/2013/KF761675	.....	S.....	E.....	F.....	.....	V.....	.....	F.....	F.....	D.....
JPN/2013/LC063836	.....	S.....	E.....	F.....	.....	V.....	T.....	F.....	D.....	
JPN/2014/LC063845	.....	S.....	E.....	F.....	.....	V.....	.....	F.....	D.....	
KH/Japan/AB548622	I.....	E.....	.....	V.....	F.....	.....	V.....	L.....	F.....	D.....
NK/Japan/AB548623	.....	.....	SSGG.....	F.....	.....	V.....	.....	L.....	F.....	F.....
Thailand/2008/KC764953	.....	S.....	E.....	F.....	.....	V.....	.....	F.....	D.....	
Thailand/2008/KC764952	.....	S.....	E.....	F.....	.....	V.....	.....	F.....	D.....	
Thailand/2010/KC764955	.....	.....	D.....	F.....	.....	V.....	I.....	F.....	D.....	
Thailand/2011/KC764959	.....	S.....	D.....	F.....	.....	V.....	.....	F.....	D.....	
Thailand/2012/KC764958	.....	S.....	D.....	F.....	.....	V.....	.....	F.....	D.....	
Thailand/2013/KF724938	.....	S.....	E.....	F.....	.....	V.....	A.....	F.....	D.....	
Thailand/KF724938	.....	S.....	E.....	F.....	.....	V.....	.....	F.....	D.....	
HUA PED45/VN/KP455313	.....	S.....	E.....	F.....	.....	V.....	S.....	G.....	Y.....	F.....
HUA PED47/VN/KP455314	.....	S.....	E.....	F.....	.....	V.....	G.....	F.....	D.....	
HUA PED67/VN/KP455319	.....	S.....	E.....	F.....	.....	V.....	.....	F.....	D.....	
HUA PED96/VN/KT941120	.....	S.....	D.....	VA.....	.....	V.....	.....	F.....	D.....	
JFP/VN/KJ960178	.....	S.....	E.....	F.....	.....	V.....	.....	F.....	D.....	
VAP/VN/KJ960179	.....	S.....	E.....	F.....	.....	V.....	.....	F.....	D.....	
KCHY/VN/KJ960180	.....	S.....	E.....	F.....	.....	V.....	.....	F.....	D.....	
IBT/VN/2018	.....	S.....	E.....	F.....	.....	V.....	.....	FF.....	D.....	

	710	720	730	740	750	760	770	780	790	800
	<p style="text-align: center;">↓</p>									
SM98/Korea/KJ857455	TSGAVYSVTPCSPSEQAAYVNDIIVGVISLNSNFTNNRLEPQFFYHSNDGSCNTEPVLVYSNIGVCKSGSIGYVPPQYCGQVKIAPVTVTGNISIPTNFS									
DR13/Korea/JQ023161	.....D.....S.....									
DR13-V/Korea/DQ462404	.....D.....K.....L.D.....M.....									
DR13/Korea/DQ862099	.....D.....S.....S.....L.D.....M.....									
CV777/CN/KT323979	.....D.....S.....S.....L.D.....M.....									
AJ1102/CN/JX188454	.....D.....S.....S.....S.....S.....									
France/2014/KR011756	.....D.....S.....S.....S.....S.....									
CV777/Belgium/AF353511	.....D.....S.....S.....S.....S.....									
Belgium/2015/KR003452	.....D.....S.....S.....S.....S.....									
GER/2014/LM645057	.....D.....S.....S.....S.....S.....									
USA/2013/KF468753	.....D.....S.....S.....S.....S.....									
USA/2014/KJ399978	.....D.....S.....S.....S.....S.....									
USA/2014/KR265813	.....D.....S.....S.....S.....S.....									
Mexico/2014/KJ645700	.....D.....S.....S.....S.....S.....									
Korea/2002/AF500215	.....D.....G.....X.DF.....L.D.....I.....									
Korea/2008/GU180142	.....D.....L.D.....L.D.....									
Korea/2008/JN184635	.....V.D.....A.....S.....S.....S.....									
Korea/2009/GU180144	.....D.....L.....L.....									
Korea/2010/GU937797	.....D.....S.....S.....S.....S.....									
Korea/2011/KC879280	.....D.....S.....S.....S.....S.....									
Korea/2012/KC879281	.....D.....C.....S.....S.....									
Korea/2012/KJ857475	.....D.....S.....S.....S.....R.....									
Korea/2013/KJ451037	.....D.....S.....M.....S.....S.....									
Korea/2013/KJ451045	.....D.....S.....S.....S.....S.....									
Korea/2014/KJ451047	.....D.....S.....S.....S.....S.....									
Korea/2014/KM403155	.....D.....S.....S.....S.....S.....E.....									
Taiwan/2014/KP276250	.....D.....S.....S.....S.....S.....									
CN/2004/AY653204	.....D.....S.....S.....S.....S.....									
CN/2006/DQ985739	.....D.....S.....S.....S.....S.....									
CN/2010/JX501318	.....D.V.....S.....S.....S.....S.....									
CN/2011/JQ638920	.....D.....S.....S.....S.....S.....V.....									
CN/2011/JN825712	.....D.....S.....S.....S.....S.....									
CN/2012/KC210145	.....D.....S.....S.....S.....S.....									
CN/2012/JX112709	.....D.....S.....S.....S.....RS.....									
CN/2013/KF761675	.....D.....S.....S.....S.....S.....									
JPN/2013/LC063836	.....D.....S.....S.....S.....S.....									
JPN/2014/LC063845	.....D.....S.....S.....G.....S.....S.....									
KH/Japan/AB548622	.....D.....L.D.....M.....									
NK/Japan/AB548623	.....D.....S.....S.....S.....S.....									
Thailand/2008/KC764953	.....D.....I.....S.....S.....S.....S.....									
Thailand/2008/KC764952	.....D.....S.....S.....S.....S.....									
Thailand/2010/KC764955	.....D.....L.G.....T.....A.....									
Thailand/2011/KC764959	.....D.....L.G.....L.G.....A.....									
Thailand/2012/KC764958	.....H.....I.....FC.....S.....L.G.....A.....									
Thailand/2013/KF724938	.....D.....S.....S.....S.....S.....A.....									
Thailand/KF724938	.....D.....S.....S.....L.G.....T.....A.....									
HUA PED45/VN/KP455313	.....D.....S.....S.....LS.....S.....									
HUA PED47/VN/KP455314	.....D.....S.....S.....LS.....S.....									
HUA PED67/VN/KP455319	.....D.....S.....S.....S.....S.....									
HUA PED96/VN/KT941120	.....D.....S.....K.....S.....S.....									
JFP/VN/KJ960178	.....D.....S.....S.....S.....S.....									
VAP/VN/KJ960179	.....D.....S.....S.....S.....S.....									
KCHY/VN/KJ960180	.....D.....S.....S.....S.....S.....									
IBT/VN/2018	.....D.....S.....LS.....S.....									





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          910       920       930       940       950       960       970       980       990      1000
SM98/Korea/KJ857455 VVQKRSVIEDLLFNKVVVINGLGTVDDEDYKRCNCNRSVADLVCAQYYSGVMLPGVVDAAEKRLHMYASLIGGMALGGITAAALPFSYAVQARLNVYLAQLT
DR13/Korea/JQ023161 .....F.....
DR13-V/Korea/DQ462404 .....G.F.....L.S...S.H...
DR13/Korea/DQ862099 .....F.....
CV777/CN/KT323979 .....G.F.....L.T...H...
AJ1102/CN/JX188454 .....F.....V.F.....
France/2014/KR011756 .....F.....V.F.S...
CV777/Belgium/AF353511 .....F.....V.F.S...
Belgium/2015/KR003452 .....F.....V.F.S...
GER/2014/LM645057 .....F.....V.F.S...
USA/2013/KF468753 .....F.....V.F.S...
USA/2014/KJ399978 .....F.....V.F.S...
USA/2014/KR265813 .....F.....V.F.S...
Mexico/2014/KJ645700 .....F.....V.F.S...
Korea/2002/AF500215 ..HE.F.....X.....I.....F..V...
Korea/2008/GU180142 ..IH.E.F.....I.....F..V...
Korea/2008/JN184635 .....H.F.....F.....
Korea/2009/GU180144 .....I.....V..V..F.....
Korea/2010/GU937797 .....F.....V.F.S...T...
Korea/2011/KC879280 .....H..F..G.....L.....P.....V..F.....
Korea/2012/KC879281 .....H..F.....L.....V..F.....
Korea/2012/KJ857475 .....F.....V..F.S...I...
Korea/2013/KJ451037 .....F.....V..F.S...
Korea/2013/KJ451045 .....H..F.....F.S...
Korea/2014/KJ451047 .....F.....V..F.S...
Korea/2014/KM403155 .....F.....V..F.S...
Taiwan/2014/KP276250 .....F.....V..F.S...
CN/2004/AY653204 .....H..F.....F.V...
CN/2006/DQ985739 .....F.....P.....V..F.....E.L...
CN/2010/JX501318 .....F.....V..F.S...
CN/2011/JQ638920 .....F..E.....V..F.S...
CN/2011/JN825712 .....F.....V..F.S...
CN/2012/KC210145 .....F.....V..F.S...
CN/2012/JX112709 .....F.....V..F.....
CN/2013/KF761675 .....F.....V..F.S...
JPN/2013/LC063836 .....F.....V..F.S...
JPN/2014/LC063845 .....F.....V..F.S...
KH/Japan/AB548622 .....H..F.....F.....
NK/Japan/AB548623 ..IH..F.....I.....F..V...
Thailand/2008/KC764953 .....H..F.....F.....V...
Thailand/2008/KC764952 .....H..F.....F.....
Thailand/2010/KC764955 .....F.....A.....VF..F.....
Thailand/2011/KC764959 .....F.....A.....VF..F.....
Thailand/2012/KC764958 .....F.....A.....VF..F.....
Thailand/2013/KF724938 .....K.F.....I.....A.....VF..F.....
Thailand/KF724938 .....F.....A.....VF..F.....
HUA PED45/VN/KP455313 .....F.....V..F.....
HUA PED47/VN/KP455314 .....F.....V..F.....
HUA PED67/VN/KP455319 .....F.....V..F.....
HUA PED96/VN/KT941120 .....F.....V..F.S...
JFP/VN/KJ960178 .....F.....V..F.....
VAP/VN/KJ960179 .....F.....V..F.....
KCHY/VN/KJ960180 .....F.....V..F.....
IBT/VN/2018 .....F.....V..F.S...

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▼ 1010      1020      1030      1040      1050      1060      1070      1080      ▼ 1090      1100

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SM98/Korea/KJ857455  DVILQRNQQLLAESFN...  T
DR13/Korea/JQ023161  .....  T..I
DR13-V/Korea/DQ462404 .....  N.....T..I
DR13/Korea/DQ862099 .....  N.....T..I
CV777/CN/KT323979 .....  N.....T..I
AJ1102/CN/JX188454 .....  A..T
France/2014/KR011756 .....  A..T
CV777/Belgium/AF353511 .....  A..T
Belgium/2015/KR003452 .....  A..T
GER/2014/LM645057 .....  A..T
USA/2013/KF468753 .....  A..T
USA/2014/KJ399978 .....  A..T
USA/2014/KR265813 .....  A..T
Mexico/2014/KJ645700 .....  A..T
Korea/2002/AF500215 .....  S..N.....T..I
Korea/2008/GU180142 .....  A..Q.....T..I
Korea/2008/JN184635 .....  H.....Q.....A..S..I
Korea/2009/GU180144 .....  Q.....A..S..I
Korea/2010/GU937797 .....  Q.....N
Korea/2011/KC879280 .....  Q.....A..T
Korea/2012/KC879281 .....  Q.....A..T
Korea/2012/KJ857475 .....  A..T
Korea/2013/KJ451037 .....  A..T
Korea/2013/KJ451045 .....  T.....A..S..I
Korea/2014/KJ451047 .....  A..T
Korea/2014/KM403155 .....  A..T
Taiwan/2014/KP276250 .....  A..T
CN/2004/AY653204 .....  A..T
CN/2006/DQ985739 .....  H.....A..T.....S..G
CN/2010/JX501318 .....  A..T
CN/2011/JQ638920 .....  Y.....A..T
CN/2011/JN825712 .....  A..T
CN/2012/KC210145 .....  A..T.....T
CN/2012/JX112709 .....  P.....A..T
CN/2013/KF761675 .....  H..A..T
JPN/2013/LC063836 .....  A..T
JPN/2014/LC063845 .....  A..T
KH/Japan/AB548622 .....  H.....T.....V..A
NK/Japan/AB548623 .....  T..I
Thailand/2008/KC764953 .....  P.....A.....S..Q.....E..S..W..E..S..I.....T.....IN...V
Thailand/2008/KC764952 .....  Q.....A..S..I.....T.....T.....IN...V
Thailand/2010/KC764955 .....  A..T.....P
Thailand/2011/KC764959 .....  L..VA..T..A
Thailand/2012/KC764958 .....  L.....A..T
Thailand/2013/KF724938 .....  A..T
Thailand/KF724938 .....  F.....A..T..P
HUA PED45/VN/KP455313 .....  A..T.....V
HUA PED47/VN/KP455314 .....  A..T
HUA PED67/VN/KP455319 .....  A..T
HUA PED96/VN/KT941120 .....  A..T
JFP/VN/KJ960178 .....  A..T
VAP/VN/KJ960179 .....  A..T
KCHY/VN/KJ960180 .....  A.....A.....A..T
IBT/VN/2018 .....  M.....A..T.....L
  
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**Figure S1.** Comparison of amino acid sequences of S gene. The blue arrow pointed the insertions (at aa positions <sup>59</sup>NQGV<sup>62</sup> and <sup>145</sup>N), deletion (at aa position <sup>168</sup>DI<sup>169</sup>), and the substitutions at aa <sup>135</sup>DN<sup>136</sup> > <sup>135</sup>SI<sup>136</sup>, <sup>497</sup>R > <sup>T</sup><sup>497</sup>, <sup>506</sup>I > <sup>T</sup><sup>506</sup>, <sup>857</sup>V > <sup>A</sup><sup>857</sup>, <sup>1221</sup>F > <sup>Y</sup><sup>1221</sup>, and <sup>1279</sup>P > <sup>S</sup><sup>1279</sup> in S protein of IBT/VN/2018 strain when comparison with the vaccine strains CV777/CN, SM98/Korea and DR13/Korea. The red arrow pointed the substitutions at aa <sup>144</sup>N > <sup>D</sup><sup>144</sup>, <sup>294</sup>I > <sup>M</sup><sup>294</sup>, <sup>318</sup>A > <sup>S</sup><sup>318</sup>, <sup>335</sup>V > <sup>I</sup><sup>335</sup>, <sup>361</sup>A > <sup>T</sup><sup>361</sup>, <sup>501</sup>SH<sup>502</sup> > <sup>501</sup>IY<sup>502</sup>, <sup>682</sup>L > <sup>F</sup><sup>682</sup>, <sup>777</sup>P > <sup>L</sup><sup>777</sup>, <sup>1009</sup>L > <sup>M</sup><sup>1009</sup>, <sup>1089</sup>S > <sup>L</sup><sup>1089</sup>, <sup>1207</sup>T > <sup>D</sup><sup>1207</sup>, <sup>1229</sup>S > <sup>G</sup><sup>1229</sup>, and <sup>1251</sup>D > <sup>E</sup><sup>1251</sup> in S protein of IBT/VN/2018 strain when comparison with the vaccine strains AJ1102/CN, CV777/CN, SM98/Korea and DR13/Korea.