### IJ"-=H9@K9>"ILIL"

"

### GE5?64@C=5".5EH9>:ECF"

# ;9<<"\$=5=>:";>=?>4@A"&9B4>C@95C"=D";6E<=:=B6F"

### \$45546"\$789:"

# #\$%"&% ' ( ) \*+#, ) "-+# . \*%" ( /"0 . &, ) ,+1"\*%2,%3 ""

"

"

"

"

+GM#\*+)#N!

#69"P<4E@"C64C"078EPE4<">9HE9R"E:"45CEa89@=P>4CEP"458"C69>9D=>9"E<9?ECE@4C9"B=:9:"4"

:9>E=7:"P64<<95?9"C="C69"<9?ECE@4PF"=D"C69"B>4PCEP9N",D"Q78EPE4<">9HE9R"E:"45CEa89@=P>4CEPA"EC:" 909>PE:9"R=7<8"7589>@E59"C69"H9>F"9::95P9"=D"=7>":F:C9@"=D"?=H9>5@95CN" - =C"B7>9<F"E5"C69":95:9" C64C"EC"R=7<8"HE=<4C9"C69":9B4>4CE=5"=D"B=R9>:"C64C"C69"D>4@9>:"899B<F"H4<798"458"R6EP6"C69":C4C9" :99V:"C="4869>9"C="458"B>9:9>H9A "K7C"@=>9"B<4E5<F"E5"C69":95:9"C64C"R9"<EH9"E5"4"89@=P>4PFA"458"ED" 4"B>4PCEP9"E:"45CEa89@=P>4CEPA"EC"E:"45CEC69CEP4<"C="458"7589>@E59:"C69"<9?ECE@4PF"=D"C64C":F:C9@"=D" ?=H9>5@95CN"

 $GF" \eqref{GF} = Certer \eqref{GF} = Certer$ 

#6E: "B4B9>"8=9:"5=C"B>9:95C"4"P=5P9BCE=5"=D"89@=P>4PF"C64C"=7C<E59:":B9PEDEP"4PCE=5:"4" ?=H9>5@95C"=7?6C"C="8="E5"=>89>"C="B>=P7>9"<9?ECE@4C9"4>>45?9@95C:N" \* 4C69>A"EC"=B9>4C9: "D>=@"C69" B9>:B9PCEH9"=D"R64C"?=H9>5@95C: "=7?6C"C="8="C="4H=E8"E<<9?ECE@4C9"4>>45?9@95C:N" / =>"E5:C45P9A"

<sup>&</sup>quot;be078EPE4<">9HE9Rf"E: "B=<ECEP4<<F"E<<9?ECE@4C9A":="D4>"4:"89@=P>4CEP"H4<79:"4>9"P=5P9>598c" X 3 4<8>=5A" A" ! J \ JZ"

P=5P<789"C64C"R64C"@4V9:"()78EPE4<">9HE9R"P=@B9<<E5?"458"7:9D7<":E@7<C459=7:<F"59P9::EC4C9:"C64C" EC"5=C"K9"=H9>7:98\\""

,5"488ECE=54"C69":P=B9"=D"@F"B4B9>"RE<<"K9"45"454<F:E:"=D"Q78EPE4<">9HE9R "REC6E5"C69" + @9>EP45"B=<ECEP4<"<458:P4B9"458","C69>9D=>9"@4E5<F">9<F"=5"1=PV9d:":=PE4<"P=5C>4PC"C69=>FN"#69" 4>?7@95C"C64C"Q78EPE4<">9HE9R "E:"5=C"4"59P9::4>F"=>"7:9D7<"89@=P>4CEP"B>4PCEP9"K9P47:9"C69>9"4>9" 89@=P>4CEP"P=75C>E9:"C64C"8="5=C"64H9"Q78EPE4<">9HE9R "458"4>9"R=>VE5?"H9>F"R9<< "E:"5=C"=59"C64C"," 488>9::N", "8E:P7::"Q78EPE4<">9HE9R "REC6E5"C69"P=5C9OC"=D"C69".5EC98"MC4C9:N",5"=C69>"P=5C9OC:A" Q78EPE4<">9HE9R "@E?6C"K9"899@98"@=>9"=>"<9::"7:9D7<""

;+\*#",

7589>:C458E5?"C64C"ED"EC"HE=<4C9:"C6E:":9<Da>7<9A"EC"E:"5=C"<9?ECE@4C9"458"P45"K9">9B<4P98"KF"4"59R" :F:C9@"=D"E5:CEC7CE=5:"9:C4K<E:698"KF"EC:":=H9>9E?5"PECES95:N""

 $+"B \ge B9 > "P = 5P9BCE = 5" = D"89@ = P > 4PF": 6 = 7 < 84" \\ \notin V9"C6 = : 9" = D"C69": = PE4 < "P = 5C > 4PC"C > 48ECE = 54"K9"$  D = 75898"7B = 5"C69" = > E?E5" = D": = PE9CFN" + : "1 = 7E: " + <C67: :9 > "B7C: "EC4"B6E < := B69 > : " = D"54C7 > 4 < <4R"458" = D" C69": = PE4 < "P = 5C > 4PC"4 < <"K9?E5"C69E > "C69 = > E9: "KF"E5C9 > B > 9CE5?"C69" = > E?E5" = D": = PE9CF" = > "bC69"9@9 > ?95C" : (4C9Nc" # 69F"B > 9: 95C"8EDD9 > E5?"P = 5P9BCE = 5: "U"b > E:E5?"D > = @"C69"94 > C6" < EV9"B7@BVE5:c": 4E8" \$ = KK9: A"  $b 54V98c": 4E8" * = 7: :947"U"K7C"7: 9"C6E: ":4@9": (24 > CE5?"B = E5C_"C69": (24C9" = D"54C7 > 9N" #67: A"488 > 9: :E5?"$  89@ = P > 4CEP"E5: CEC7CE = 5: "E5"C69"? > 94C9 > "P = 5C9OC" = D"6 = R"C69F"4 > 9"P = 5P9EH98"E: ":= @9C6E5?"C69F"4 <<" 899@"45"E5C9? > 4 < "B > 9P7 > := >"C = "C69"89@ = P > 4CEP"B > = P9: :N""

",5"488ECE=54"C69"P=@@=5"895=@E54C=>"=D"C69":=PE4<"P=5C>4PC"C>48ECE=5"4:"C69"=>E?E5"=D" :=PE9CF"?959>4C9:"4"B>=B9>"P=5P9BCE=5"=D"89@=P>4PF"C64C"P<=:9<F"4869>9:"C="C69">E?6C:"?>45C98"E5" C6E:"=>E?E54<":C4C9N"ME5P9"R9"64H9">E?6C:"E5"C69":C4C9"=D"54C7>9A"R9"=7?6C"C="64H9"C69@"B>=C9PC98"KF" C69"E5:CEC7CE=5:"C="R6EP6"R9"C>45:D9>"C6=:9">E?6C:N"+:"+<C.2(=:) - 2(:) - 0.2418583...2(9)0.2(8"KF")] 458"P=58ECE=5:"=D":9<Da>7<9"4>9"5=("B>9:9>H98A"C64("89@=P>4PF"P45"K9"<9?ECE@4C9<F"=H9>C6>=R5"458" >9B<4P98N"

,"8E:P7::"C6E:"4KEECF"C="=H9>C6>=R"P7>>95C"E5:CEC7CE=5:"458"9:C4K<E:6"59R"=59:"C64C"K9:C" >9B>9:95C"EC:"PECES95:"E5"C9>@:"=D"C69">E?6C"C=">9H=<7CE=5":9P7>98"KF"C69":=PE4<"P=5C>4PC"C>48ECE=5N" #69":=PE4<"P=5C>4PC"C>48ECE=5"=7C<E59:"H4>FE5?"PE>P7@:C45P9:"R69>9"C69">E?6C"C=">9H=<7CE=5" (7:CEDE98N","7:9"1=PV9d:"P=5P9BCE=5"=D"C69">E?6C"C=">9H=<7CE=5"K9P47:9"EC"E:"B4>CEP7

### $4 @ \text{KECE} = 5 \text{A}"D94 \text{A}"D = <<\!\!F" =>\!\!P = >\!\!7BCE = 5 \text{A}"95894H =>\!\!"C = "?>\!\!4 : B"C69 @ : 9 <\!\!H9 : \text{A}" =>\!"B7C"E5C = "C69"6458 : "=D"$

45F"=C69>"45"4K:=<7C9"B=R9>"=H9>"C69"<EH9:A"<EK9>CE9:A"458"9:C4C9:"=D"C69"B9=B<9%C

#3 (")% - #\* + 1"/, k . \*%M", -"0 . &, ) + 1"\*%2, %3 !!

,"4>?79"C64C"Q78EPE4<">9HE9R "P45"K9"4"7:9D7<"C==<"E5"@4E5C4E5E5?"C69"<9?ECE@4C9"P=58ECE=5:" =D"89@=P>4PF"KF"454<FSE5?"C69"R=>V:"=D"CR="8E::95CE5?"C69=>E:C:\_"M4@79<"/>>99@45"458"09>9@F" 3 4<8>=5N"/>99@45"P=5C958:"C64C"Q78EPE4<">9HE9R"E:"?959>4<<F"<9?ECE@4C9A"R6E<9" 3 4<8>=5"P=5C958:" C64C"EC"E:"?959>4<<F"E<9?ECE@4C9N"#69F"94P6">9:C"C69E>"4>?7@95C:"=5"P=5C>4:CE5?"89DE5ECE=5:"=D" 89@=P>4PF"458"89@=P>4CEP":=H9>9E?5CFN",5"=>89>"C="4>?79"C64C"Q78EPE4<">9HE9R"E:"69<BD7<"E5" @4E5C4E5E5?"89@=P>4CEP":=H9>9E?5CFN",5"=>89>"C="4>?79"C64C"Q78EPE4<">9HE9R"E:"69<BD7<"E5" @4E5C4E5E5?"89@=P>4PFA"B>=B9><F"P=5P9EH98A","454<FS9"/>99@45d:"458" 3 4<8>=5d:"E58EHE874<" P=5P9BCE=5:"=D"89@=P>4PF"458"B=<ECEP:"C64C"?>=758"94P6"=D"C69E>"4>?7@95C:"E5">9<4CE=5"C="4"B>=B9>" P=5P9BCE=5:"=D"89@=P>4PFN"!

,5"4>?7E5?"C64C"(78EPE4<">9HE9R "E: "?959>4<F"E<9?ECE@4C9A" 3 4<8>=5"7CE&ES9:"4"P=5H95CE=54<" 89BEPCE=5"=D"89@=P>4PF"C64C"P95C9>:"EC:9d"4>=758"EC:"B=&ECEP4<"E5:CEC7CE=5:A":7P6"4:">9B>9:95C4CEH9" <9?E:<4C7>9:N" 3 695" 3 4<8>=5"B<4P9:"P=58ECE=5:"=5"6E:"4>?7@95C"C64C"(78EPE4<">9HE9R "E: "45CEa 89@=P>4CEPA"69"6E?6<E?6C:"89DE5E5?"D94C7>9:"=D"6E:"P=5P9BCE=5"=D"89@=P>4PFN"GF">9T7E>E5?" 89@=P>4CEPA"69"6E?6<E?6C:"89DE5E5?"D94C7>9:"=D"6E:"P=5P9BCE=5"=D"89@=P>4PFN"GF">9T7E>E5?" 89@=P>4CEPTE5:CEC7CE=5:"REC6"b4">9B>9:95C4CEH9"<9?E:<4C7>9"9<9PC98"=5"C69"K4:E:"=D"75EH9>:4<"487<C" :7DD>4?9c"458"(78EPE4<"E5:CEC7CE=5:"b:9C"7B"=5"4"5=5>9B>9:95C4CEH9"K4:E:"C="694>"E58EHE874<" <4R:7EC:Ac" 3 4<8>=5"?959>4C9:"4"P=5P9BCE=5"=D"89@=P>4PFT"C64C"E:"P95C9>98"4>=758"D=>@4<"9T74<" 4PP9:::"C=":7P6"E5:CEC7CE=5:A"=C69>RE:9"V5=R5"4:"9T74<"B=<CEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECC7CE=5:A"=C69>RE:9"V5=R5"4:"0T74<"B=<CEP4<">ECEP4<">ECEP4<">ECEP4<">=904@B<9A"E5"9<9PCE5?" <9?E:<4C=>:"C=">904@B<9A"E5"9C9@A"9H9>F"E58EHE874<" <4C=>:"C=">94P6"PECES95N"/=>"904@B<9A"E5"9<PCE5?" </P>

["

B4>CEPEB4C9"=5"C69":4@9":P4<9"XEN9N"=59"H=C9"B9>"B9>:=5ZA"9H9>F"E58EHE874<"64:"45"9T74<"=BB=>C75ECF" D=>"69>"H=EP9"C="K9"P=5:E:C95C<F"694>8"458">9B>9:95C98"E5"89@=P>4CEP"B>=P987>9:N"

/>99@45a''=5''(69)='(6458a''E5(9))=2(69)='(64)='(69)='(69)='(69)='(69)='(69)='(69)='(64)='(64)='(69)='(69)='(69)='(69)='(69)='(64)='(64)='(69)='(69)='(69)='(69)='(69)='(64)='(64)='(69)='(69)='(69)='(69)='(69)='(64)='(64)='(69)='(69)='(69)='(69)='(69)='(64)='(64)='(69)='(69)='(69)='(69)='(69)='(69)='(69)='(64)='(69)='(60)

%T74<"K4:EP">E?6C:A"=C69>RE:9"V5=R5"4:"54C7>4<">E?6C:A"4>9">E?6C:"C64C"9OE:C"D=>"4<<"B9=B<9A" E5"4<<"PE>P7@:C45P9:A"7589>"4<"P=58ECE=5:N"#6E:":9C"=D">E?6C:"R6EP6"/>99@45"7CE<ES9:"E5"6E:" 89DE5ECE=5"=D"89@=P>4CEP":=H9>9E?5CF"R9>9"=>E?E54<<F"=7C<E598"KF"0=65"1=PV9A"R6="P<4E@98"C64C" b94P6"B9>:=5"64:"C69">E?6C"C="8="R64C9H9>":69"P6==:9:"REC6"R64C9H9>":69"<9?ECE@4C9<F"=R5"":=" <=5?"4:":69"8=9:"5=C"HE=<4C9"C69">E?6C:"=D"=C69>:"5=C"C="K9"64>@98"E5"P9>C4E5"R4F:mKF"D=>P9A"

**∆**"J^I"

!L"

<sup>&</sup>quot;/>99@45A"

<sup>&</sup>quot;b4"B>=P987>4<"P=5P9BCE=5"=D"89@=P>4PFA"4PP=>8E5?"C="R6EP6"89@=P>4PF"E:"9::95CE4<<F"4"D=>@"=D" ?=H9>5@95C"89DE598"KF"9T74<"B=<ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<">ECEP4<</ECEP4<">ECEP4<">ECEP4<</ECEP4<">ECEP4<</ECEP4<">ECEP4<</ECEP4<</ECEP4<</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP4</ECEP

B4>CEPEB4CE=5A"E5P<78E5?"D4E>"458">9?7<4>"9<9PCE=5:"R69>9"9H9>F"E58EHE874<"H=C9"P=75C:"9T74<<FN" #6E:":F:C9@"9@B64:ES9:"C69"H4<79"=D"C69"E58EHE874<"H=C9"458"@4Q=>ECF">7<9N"#6E:"E:"E5"&E59"REC6"6E:" >E?6C:aK4:98"P=5P9BCE=5"=D"B=<ECEP:"C64C"P=5P9EH9:"=D"C69"<9?E:<4C7>9"4:"K9E5?"4K<9"C="9DD9PCEH9<F" B>=C9PC">E?6C:N"078EPE4<">9HE9R"R=7<8"954K<9"759<9PC98"=DDEPE4<:"U"Q78?9:"U"C="90C>459=7:<F"8="C64C" R6EP6" 3 4<8>=5"K9<E9H9:"89@=P>4CEP4<<F"9<9PC98"=DDEPE4<:"U"<9?E:<4CEH9">9B>9:95C4CEH9:"U"4>9"@=>9" C645"P4B4K<9"=D"8=E5?N"ME5P9" 3 4<8>=5"=5<F"488>9::9:"9T74<"B=<ECEP4<>ECEP4<>E76C:"E5"6E:"P=5P9BCE=5"=D" 89@=P>4PFA"4"B>4PCEP9"<EV9"Q78EPE4<">9HE9R"R=7<8"C>45:?>9::"C69"@=:C"K4:EP"B>E5PEB<9:"=D" 89@=P>4CEP":=PE9CF"KF"7:7>BE5?"C69"B=<ECEP4<>ECEP4<>E76C:"=D"E58EHE874<:"458":7BB<9@95CE5?"C69E>"HE9R:" REC6"C6=:9"=D"759<9PC98"=DDEPE4<:N"#67:A" 3 4<8>=5"P=5C958:"C64C"Q78EPE4<">9HE9R"E:"E<<9?ECE@4C9N"

/>99@45<sup>h</sup>=5"C69=C69>"645<sup>h</sup>"P=5C95<sup>h</sup>:"C64("Q78EPE4<'>9HE9R"E:"<9?ECE@4C9N"GF"E5C9?>4CE5?" 9T74<"K4:EP">E?6C:"E5C="6E:"P=5P9BCE=5"=D"89@=P>4CEP":=H9>9E?5CF<sup>h</sup>"/>99@45"488>9::9:"D=>@:"4" P=5P9BCE=5"=D"?=H9>5@95C"E5"R6EP6":=H9>9E?5"B9=B<9"4>9"D7584@95C4<<F"4K<9"C="9:C4K<E:6"C64C" ?=H9>5@95Cd:"B=R9>N"/>99@45"90B<4E5:"C64C"E5"4"89@=P>4CEP":=H9>9E?5CF<sup>h</sup>"4:"=BB=:98"C="4"@9>9" 89@=P>4PF<sup>h</sup>":=H9>9E?5"B9=B<9"b64H9"C69"B=R9>"C="P>94C9"458"89DE59"C69"54C7>9"458"&E@EC:"=D" =>8E54>F"B=&CEP4<"47C6=>ECFc"KF"HE>C79"=D"C69"<9?ECE@4C9"89PE:E=5a@4VE5?"B=R9>:":9P7>98"KF"C69E>" 9T74<"K4:EP">E?6C:N "3EC6"C69"D==CE5?"=D"C69"<9?ECE@4C9"89PE:E=5a@4VE5?"B=R9>:":9P7>98"KF"C69E>" 9T74<"K4:EP">E?6C:N "3EC6"C69"D==CE5?"=D"C69"<4E<ECF"=D":=H9>9E?5:"C="7:9"C6=:9">E?6C:"C="89DE59"47C6=>ECFA" />99@45"P=5C958:"C64C"Q78EPE4<">9HE9R"E:"=59"=D"C69"@45F"B>=P987>4<"4:B9PC:"=D"89@=P>4CEP" :=H9>9E?5CF"C64C"bD99"458"9T74<":=H9>9E?5"B9>:=5:c"@E?6C"4?>99"C="9:C4K<E6N

! J"

>E?6C:N",5"/>99@45d:"R=>8:A"Q78EPE4<">9HE9R"P45"K9"7589>:C==8"4:"b4":64>98"B>9P=@@EC@95C"KF" D>99"458"9T74<"PECES95:"C="@4E5C4E5"C69"P=58ECE=5:"=D"C69E>":=H9>9E?5CFc"458"P45"C67:"K9" <9?ECE@4C9<F"P=5P9EH98N ""

,5"@4VE5?"C6E:"4>?7@95CA"/>99@45"6E?6CE?6CE?6CE?4"P=5P9BC74<ES4CE=5"=D"B=<ECEP:"C64C" >9P=?5ES9:"D4PC=>:"K9F=58"8EDD9>E5?"P=5P9BCE=5:"=D">E?6C:"C64C"E5D<795P9:"C69E>"89PE:E=5:N"/>99@45" :B94V:"=D"89@=P>4CEP"B4>CEPEB4CE=5"REC6"C69"7589>:C458E5?"C64C"B9=B<9"64H9"C69E>"=R5"B9>:=54<" E5C9>9:C:"C64C"P45"E5D<795P9"C69E>"B=<ECEP4<"89PE:E=5a@4VE5?N"/>99@45":C4C9:A"b>4CE=54<"E58EHE874<:" P=5P9>598"REC6"C69"D>998=@"C="89C9>@E59"458"C69":=PE4<"P=58ECE=5:"D=>"C69"48H45P9@95C"=D"C69E>" 958:"64H9"45" "E5"E5D<795PE5?"C69"B=<ECEP4<"B>=P9::9:"C64C"89C9>@E59"C69"<4R:":E?5EDEP45C<F" 4DD9PCE5?"C69E>"B>=:B9PC:Nc "/>99@45">9P=?5ES9:"C69">94<ECF"C64C"H4>E=7:"PE>P7@:C45P9:"=>" B>9D9>95P9:"=D"E58EHE874<:"P45"4DD9PC"C69E>"B=<ECEP4<"89PE:E=5a@4VE5?N"

/>99@45d:"P=5P9BCE=5"=D"B=<ECEP:"4:"4"@45ED9:C4CE=5"=D"P=@B9CE5?"E5C9>9:C:"95645P9:"6E:" \*4R<:E45"4>?7@95C"C64C"Q78EPE4<">9HE9R"P=7<8"K9"7589>:C==8"4:"C6E:"b:64>98"B>9P=@@EC@95CC"KF" B=E5CE5?"C=R4>8:"9HE895P9"C64C"R=7<8"E5P95CEHES9":=H9>9E?5:"C="E@B<9@95C":7P6"B>=C9PCE=5:N",5" 6E?6<E?6CE5?"C69"D4PC"C64C"E5C9>9:C:"P45"E5D<795P9"E58EHE874<"89PE:E=5a@4VE5?A"/>99@45"B=E5C:"C="4" C45?EK<9"C6>94C"C="C69"9T74<"K4:EP">E?6C:":9P7>98"KF"4"89@=P>4CEP":=H9>9E?5CFN"#6E:"C6>94C"P=7<8" 7589>@E59" 3 4<8>=5d: "P=58ECE=5"C64C"@9@K9>:"=D"4":=PE9CF"8E:B<4F"4"P=@@EC@95C"C=">E?6C:N" 3 4<8>=5d: "89DE5ECE=5"=D"4"P=@@EC@95C"C=">E?6C:">9T7E>9:"C64C"PECES95:"4PV5=R<98?9"C69"D4PC"bC64C" E58EHE874<:"64H9"P9>C4E5"E5C9>9:C:"458"4>9"95CEC<98"C="P9>C4E5"<EK9>CE9:"C64C":6=7<8"5=C"K9"895E98" :E@B<F"K9P47:9"EC"R=7<8"K9"@=>9"P=5H95E95C"D=>"@=:C"B9=B<9"C="895F"C69@Nc",5"9::95P9A"EC" >9T7E>9:"C64C"E58EHE874<:"P=5:E89>"C69"E5C9>9:C:"=D"=C69>:"R695"B=<ECEP4<<F"B4>CEPEB4CE5?N"W9CA"EC"

A"!Ji^"

A"J^J"

!^"

<sup>&</sup>quot; JI["

<sup>&</sup>quot;/>99@45&"

<sup>&</sup>quot; 3 4<8>=5A"

59?<9PC: "C="488>9:: "C64C"E58EHE874<: "P45": E@7<C459=7:<F"B=C95CE4<<F"P=5: E89>"C69E>"=R5"E58EHE874<" E5C9>9: C: "R695"8=E5?":=N"

#\$%"\*(1%"(/", - #%\*%M#M", - "\*%2%+1, - k"+";\*(;%\*")(-)%;#,(-"(/"&%' ()\*+)W"

,5"=>89>"C="4::9::"R6EP6":C45P9"=5"Q78EPE4<">9HE9R"E:"P=>>9PCA"R9"@7:C"4::9::"R6EP6"C69=>F" =B9>4C9:"REC6E5"4"B>=B9>"P=5P9BCE=5"=D"89@=P>4PFN"+:"/>99@45"B7C:"ECA"b7<CE@4C9<FA"C69"P4:9"D=>"

 $<sup>\</sup>label{eq:based_$ 

# C69:9">E?6C:"4>9A","P=5P989"C64C":=@9"=D"C69:9">E?6C:A"4C"<94:C"E5"H9>F"K4:EP"=7C&59A"@E?6C"E5P<789" >E?6C:"=D"C69"B9>:=5A":7P6"4:"C69">E?6C"C="E5C9?>ECFA"47C=5=@FA"458"879"B>=P9::N"

,5"488ECE=5A"C69>9"4>9"H4>E=7:"PE>P7@:C45P9:"C64C"P45"HE=<4C9"4"89@=P>4PFA"B>=B9>F"
P=5P9EH98A"K7C","8E:P7:::C6E:"B695=@95=5"B>E@4>E<F"E5"C9>@:"=D"C69"8E::95CE5?"B=E5C:"E5"
/>99@45d:"458" 3 4<8>=5d:"4>?7@95C:N"#69"D7584@95C4<"8EDD9>95P9"K9CR995"/>99@45d:"458"
3 4<8>=5d:"P=5P9BCE=5:"=D"89@=P>4PF"E:"C64C"/>99@45d:"E5P<789:"9T74<"K4:EP">E?6C:"458"
3 4<8>=5d: "8=9:"5=CN"ME@E<4><FA"C69"D7584@95C4<"8EDD9>95P9"E5"C69E>"P=5P9BCE=5:"=D"B=C64C"
/>99@45"4PP=75C:"D=>"E58EHE874<"E5C9>9:C:"458" 3 4<8>=5"8=9:"5=CN"/>99@45d:"P=5P9BCE=5"=D"
89@=P>4CEP":=H9>9E?5CF"4PP=75C:"D=>"PECES95:d"54C7>4<">ECC"C="9:C4K<E:6"EC:"=R5"89@=P>4CEP"
E5:CEC7CE=5:"458"6E?6<E?6C:"4">94<E:CEP"D4PC=>"U"E5C9>9:C:"U"C64C"P=7<8"R4>>45C"C69"909>PE:9"=D"C6E:"
54C7>4<">E?6CN""

# \$%") ( - M% p . % - )%M" ( /" 3 + 1&\* ( - dM"+ - &" / \*%% ' + - dM" 2,% 3 M" ( - "; ( 1,#, ) M"

 $+ \langle c6=7?6"/ \rangle 99@45d:"P=5P9BCE=5"=D"89@=P>4PF"E:"E894\langle E:CEP"458"7CE\langle ES9:"4"5=\rangle@4CEH9"\langle 95:A"$   $(c64C"8=9:"5=C"47C=@4CEP4<\langle F"@945"69"P=5P9EH9:"=D"89@=P>4PF"B>=B9>\langle FN"' = >9=H9>A"6E:"E5C9?>4CE=5"$  =D"C69":=PE4<"P=5C>4PC"(>48ECE=5"@E?6C"P=@B9<"7:"C="4PP9BC"6E:"P=5P9BCE=5"R6=<9694>C98<FA":E5P9"EC"  $9:C4K\langle E:69:"4":C>=5?"6E:C=>EP4<"B>9P9895C"D=>"6E:"4>?7@95CN" $=R9H9>A"C6E:"4<=59"E:"5=C"95=7?6"C="$  4::7@9"C64C"6E:"P=5P9BCE=5"E:"4PP7>4C9A"4:"6E:C=>EPE:@"=>"@4E5C9545P9"=D":C4C7:"T7="P45"59H9>"K9" (c69":=<9"89C9>@E545C"=D"4"B>4PCEP9d:"H4<E8ECFN", 5"=>89>"C="9H4<74C9"C69"@9>EC:"=D"94P6"P=5P9BCE=5" =D"89@=P>4PFA"R9"@7:C"9H4<74C9"C69"B>4PCEP4<">4@EDEP4CE=5:"=D"K=C6" 3 4<8>=5d:"458"/>99@45d:" 7589>:C458E5?:"=D"89@=P>4PF"458"6=R"C69F"4<E?5"REC6">94<ECFN"

<sup>&</sup>quot;#69>9"4>9"@45F"904@B<9:"D=>"C6E:]"45C9K9<<7@":<4H9>FA"D=>"E5:C45P9A"P455=C"K9"Q7:CEDE98"=5"C69"?>=758:"C64C"EC"R4:"4"P95C7>E9:"=<8"B>4PCEP9N"

;9>64B:"0459d:"89PE:E=5"C="H=C9"D=>"C69"P=5?>9::R=@45">9D<9PC98"69>"=R5"B9>:=54<" P=5P9BCE=5"=D">E?6C:N";9>64B:"69>"P=5P9BCE=5"=D"C69">E?6C"C="K=8E<F"E5C9?>ECF"E5P<789:"C69">E?6C"=D" 9H9>F"E58EHE874<"C="K9"P<=C698"458"D98N" \$9>9A" 3 4<8>=5d: "P=5P9BCE=5"=D"B=<ECEP:"E: "C==":E@B<E:CEPN" \$E:"7589>:C458E5?"=D"B=<ECEP:"4:"4"@9>9"90B>9::E=5"=D"8EDD9>E5?"E58EHE874<"P=5P9BCE=5:"=D">E?6C:" 5=C"=5<F"4::7@9:"C64C"4<<"@9@K9>:"=D"89@=P>4CEP":=PE9CE9:"8E:B<4F"4"P=@@EC@95C"C=":=@9" P=5P9BCE=5"=D">E?6C:"R695"C69F"H=C9A"EC"4<:="E?5=>9:"45F"=C69>"P=5:E89>4CE=5:"B9=B<9"@E?6C"@4V9" R695"8=E5?":=N",C"E:"B<47:EK<9"C64C"0459"C==V"C69"DE545PE4<"E::79"E5C="4PP=75C"R695":69"H=C98"D=>" C69"P=5?>9::R=@45A":E5P9":69"V59R":69"R=7<8"K9"48H9>:9<F"4DD9PC98"KF"C69"P=5?>9::R=@45d:" =BB=595Cd:"B<45"C=":<4:6"C69"K78?9C"=D"H4>E=7:"?=H9>5@95C":9>HEP9:N"#69>9D=>9A"0459"P=7<8"64H9"

!["

K995"@=CEH4C98"KF":=@9C6E5?"=C69>"C645"4"B9>:=54<"P=5P9BCE=5"=D">E?6C:]"0459"E:"B<47:EK<F" B=<ECEP4<<F":R4F98"KF"69>"B9>:=54<"E5C9>9:C:N"

3 6E<9" 3 4<8>=5d: "P=5P9BCE=5"=D"B=<ECEP:"E: "5=C"P=@B<9C9<F"E54PP7>4C9A"6E: "P=5P9BCE=5"=D" E58EHE874<"B=<ECEP4<"B4>CEPEB4CE=5"4: "4"@9>9"9OB>9: :E=5"=D"8EDD9>E5?"P=5P9BCE=5: "=D">E?6C: "E?5=>9: " 45"E@B=>C45C"P=5:E89>4CE=5"C64C"B9=B<9"@E?6C">94<E:CEP4<<F"@4V9"R695"B=<ECEP4<<F"B4>CEPEB4CE5?N",5" B4>C"CR=A", "4>?79"C64C"KF"5=C"4PP=75CE5?"D=>"E58EHE874<"E5C9>9:C: "E5"6E: "P=5P9BCE=5"=D"89@=P>4PFA" 3 4<8>=5"59?<9PC: "C=":7BB=>C"6E: "4>?7@95C"C64C"(78EPE4<">9HE9R "E: "45CEa89@=P>4CEPA"458"C69>9D=>9" E<<9?ECE@4C9A"REC6E5"4"B>=B9>"P=5P9BCE=5"=D"89@=P>4PFN", "454<FS9"6=R" 3 4<8>=5d: "P=5P9BCE=5"=D" 89@=P>4PF"8=9: "5=C"4PP=75C"D=>"C69"E<9?ECE@4C9"4>>45?9@95C: "C64C"P45"K9"?4>59>98"D>=@"C69" =H9>90C95:E=5"=D"E58EHE874<"E5C9>9:C: A"5=>"8=9: "EC"4PV5=R<98?9"PECES95:d"4KE<ECF"4: ":=H9>9E?5: "C=" 9:C4K d: 6"C69E>"=R5":F:C9@"=D"?=H9>5@95CN", 5"454<FSE5?"C69"B>4PCEP4<">4@EDEP4CE=5: "=D"94P6"=D" C69:9"C69=>E9:A", "C695"6E?6d?6C"C69":B9PE4<"54C7>9"=D"(78EPE4<">9HE9RN"

#### ;+\*#",,"

;\*()%&.\*%M"+-&"#\$%",';\*(;%\*")(-)%;#,(-"(/"&%'()\*+)W"+M" %r%';1,/,%&"#\$\*(.k\$"G\*(3-"2N"G(+\*&"(/"%&.)+#,(-"

+"B>=B9>"P=5P9BCE=5"=D"89@=P>4PF"E:"=59"C64C"4H9>C:"45"=H9>90C95:E=5"=D"E58EHE874<" E5C9>9:C:N", D"E58EHE874<"E5C9>9:C:"B9>@94C9"B=<ECEP4<"89PE:E=5"@4VE5?A"C69"9T74<"K4:EP">E?6C:" :=H9>9E?5:"4>9"?>45C98"E5"C69":C4C9"=D"54C7>9"458"C>45:D9>>98"C="C69"?=H9>5@95C"P45"K9" C>45:?>9::98A"R6EP6"E5"C7>5"89H=<H9:"45F"P=5P9BCE=5"=D"89@=P>4PF"C64C"E:"K=>5"=7C"=D"C69":=PE4<" P=5C>4PC"C>48ECE=5"E5C="45"E<<9?ECE@4C9":C4C9N"ME5P9"B>=P987>4<"P=5P9BCE=5:"@9>9<F":9P7>9"9T74<" B=<ECEP4<">E2CEP4<">E?6C:A"C69F"P455=C"489T74C9<F"@ECE?4C9"4?4E5:C"B=C95CE4<<F"845?9>=7:"@4Q=>EC4>E45" E5C9>9:C:"C64C"E5D>E5?9"=5"PECES95:d"K4:EP">E?6C:"458"89<9?ECE@ES9"4"89@=P>4PFN"#="E<7:C>4C9"C69"

D4PC"C64C"E5C9>9:C:"B<4F"4">=<9"E5"B=<ECEP4<"B4>CEPEB4CE=5"458"6=R"C69F"P45"P=@B>=@E:9"B=<ECEP4<" <9?ECE@4PFA"<9C"7:"454<FS9"C69"D=<<=RE5?":P954>E= ""

1E584"E:"4"K < 4PV"6E?6":P6 == <":C7895C"D> = @" s 45:4:A"R69>9"C69"::C4C9"P = 5:CEC7CE = 5":B9PEDE9:" :9B4>4C9":P6 == <:"D => "K < 4PV":C7895C:A" = R6EP6":69"@7:C"R4 < V"DEH9"@E < 9:"94P6"84FA",C"E:"E << 9?4 < D => "69>"C = "95> = <"E5"C69" :P6 == <"89:E?54C98"D => "R6EC9":C7895C:"4P> = ::"C69":C>99C"D > @" 69>"6 = 7:9A"#69" s 45:4:":C4C9" P = 5:CEC7CE = 5"E:"R>ECC95"KF"458"E:":7KQ9PC"C = "P645?9"XHE4">4CEDEP4CE = 5Z"KF"C69" s 45:4:":C4C9" <9?E: <4C7>9A"#69" s 45:4:":C4C9"<9?E: <4C7>9"P = 5:E:C:"=D">9B>>9:95C4CEH9:"R6="4>9"89@=P>4CEP4<<F" 9 < 9PC98"KF"PECES95:"R6 = "4>9"?>45C98"9T74 < "B = <ECEP4 < >E?6C:A" . 589>"4"B7>9<F"B>=P987>4 < "P = 5P9BCE = 5" = D"89@=P>4PFA"C6E:"=7CP = @9"=D":C4C9a:B = 5:=>98":P6 == <":9?>9?4CE = 5"R = 7<8"K9"P = 5:E89>98" B = <ECEP4 < F" 9?ECE@4C9]"C69"@4Q = > EC4> E45"9:C4K < E:6@95C" = D"C69":C4C9" < 9?E:< <4C7>9"P09PC:"9T74<" B = <ECEP4 < > 26C:"458"E:":C69>9D = > 989@ = P>4CEPA"

\*907>5E5?"C="C69"454<F:E:"=D"/>99@45d:"458" 3 4<8>=5d:"P=5P9BCE=5:"=D"B=<ECEP:"E5"B4>C"=59A"3 4<8>=5"4>?79:"4:"ED"R695":=@9=59"H=C9:A"69>"H=C9">9D<9PC:"=5<F"69>"=R5"E58EHE874<"HE9R"=D" >E?6C:N"/>99@45A"6=R9H9>A"4>?79:"C64C"69>"H=C9"E:"4<:="E5D<795P98"KF"69>"=R5"E5C9>9:C:N"#69"<4R"C=" :9?>9?4C9":P6==<:"P455=C"B=::EK<F"9@K=8F" 3 4<8>=5d:"P=5P9BCE=5"=D"B=<ECEP:"4:"4"B7>9"90B>9::E=5" =D"8EDD9>E5?"P=5P9BCE=5"=D">E?6C:N"\*9?4>8<9::"=D"R64C"C69":B9PEDEP"E5C9>9:C:"4>9"4C"B<4F"E5"C6E:" E5:C45P9"=D"9T74<"B=<ECEP4<"B4>CEPEB4CE=5A"EC"E:"P<94>"C64C":=@9C6E5?"=C69>"C645"4"P=5P9BCE=5"=D" >E?6C:"E:"K9E5?"@45ED9:C98"C6>=7?6"B=<ECEP4<"B4>CEPEB4CE=5N"#69"@=:C4F"R6EC9"<9?E:<4C7>9"R4:" E5C9>9:C98"E5"@4E5C4E5E5?":P6==<":9?>9?4CE=5"4:"4"@945:"=D"7B6=<8E5?":9B4>4CE=5"D>=@"B9=B<9" R6=@"C69F"899@98"E5D9>E=>N";9>64B:"C6E:"89PE:E=5"R4:"4<:="@489"7589>"C69"?7E:9"=D"45" E58EHE874<"P=5P9BCE=5"=D">E?6C:N" \$=R9H9>A"C69"<9?E:<4C7>9d:"H9:C98"E5C9>9:C"E5"@4E5C4E5E5?" :9?>9?4CE=5"E:"B<47:EK<F"@45ED9:C98"E5"C6E:"

II"

4<<=R:"D=>"E58EHE874<"E5C9>9:C:"C="B9>H9>C"EC:":F:C9@:"E:"45CEC69CEP4<"C="C69">E?6C"C=":9<Da?=H9>545P9" :9P7>98"KF"C69":=PE4<"P=5C>4PC"C>48ECE=5N"

,"8="5=C"RE:6"C="E@B<F"C64C"4"B>=B9>"P=5P9BCE=5"=D"89@=P>4PF"E:"=59"C64C"@ECE?4C9:"4?4E5:C" 4<<"VE58:"=D"E5C9>9:C:N","=5<F"7>?9"C64C"4"B>=B9>"P=5P9BCE=5"=D"89@=P>4PF"@ECE?4C9"4?4E5:C"C69" VE58:"=D"E5C9>9:C:"C64C"89<9?ECE@ES9"89@=P>4CEP"E5:CEC7CE=5:A"C69>9D=>9"R4>>45CE5?"C69E>" >9B<4P9@95CN","P=5C958"C64C"E5C9>9:C:"=5<F"89<9?ECE@ES9"89@=P>4CEP"E5:CEC7CE=5:"R695"C69F"E5D>E5?9" =5"C69">E?6C"C=":9<Da>7<9"?>45C98"C="PECES95:"E5"C69":C4C9"=D"54C7>9N""

EC: "=R5": P6==<: "KF": C4C9"<9?E: <4CE=5A"D>99"=D"D989>4<"E5C9>H95CE=5N"#69F"P=7<8":=7>P9"C6E: ">E?6C"E5" C69"9T74<"B=<ECEP4<">E?6C: "?>45C98"C="4<<"PECES95: "C="9<9PC"C69"<9?E: <4C7>9"C64C"B4:: 98"C6E: "4@958@95C" C="C69": C4C9"P=5: CEC7CE=5"458"Q7: CEDF"C69": C4C7C9"4: "4"@45ED9: C4CE=5"=D"C69" RE<<"=D"C69"@4Q=>ECFN" \$=R9H9>A": 7P6"B=<ECEP4<"89PE: E=5"@4VE5?"?959>4C9: "E<9?ECE@4C9"4>>45?9@95C: "C64C"HE=<4C9"9T74<" K4: EP">E?6C: N" 078EPE4<">9HE9R "P45"K9"4"7:9D7<"C==<"C="@4E5C4E5"<9?ECE@4PF"KF"95:7>E5?"C64C"4"8=P7@95C" R6EP6"?>45C:"C69":9\da>7<9"458"@45F"=D"C69"K4:EP">E?6C:":9P7>98"KF"C69":=PE4<"P=5C>4PC"C>48ECE=5"E:" B>9:9>H98N"#69"P=5:CEC7CE=5">9B>9:95C:"4"8=P7@95C"9:C4K<E:698"KF"D>99"458":=H9>9E?5"B9=B<9N"+:" />99@45"5=C9:A"b4"89@=P>4CEP"P=5:CEC7CE=5"E:"4"54C7>4<"90C95:E=5"=D":=PE4<"P=5C>4PC"HE9RNc "+" P=5:CEC7CE=5"E:"4"8=P7@95C"C64C"9@K=8E9:"89@=P>4CEP":=H9>9E?5CFN",C"E:"4"P=5C>4PC74<"4?>99@95C" 9:C4K<E:698"KF":=H9>9E?5"E58EHE874<:"=7C<E5E5?"C69"P=58ECE=5:"=D"C69E>":F:C9@"=D"?=H9>5@95CN" (59"

N",5"4"1=PV945":95:94"EC"95D=>P9:"C69">E?6C:"C64C"B9=B<9"4>9"?>45C98"E5"C69":C4C9"=D"54C7>9"K7C" C>45:D9>>98"C="C69"?=H9>5@95CN"#67:A"EC"E:"E5"4"?=H9>5@95Cd:"K9:C"E5C9>9:C"C="B>9:9>H9"C69" P=5:CEC7CE=5N" (C69>RE:9A"EC:"PECES95:"R=7<8"<9?ECE@4C9<F"?4>59>"4"1=PV945">E?6C"C=">9H=<7CE=5"458" P=7<8"C6>94C95"C69"?=H9>5@95Cd:"P=5CE5798"9OE:C95P9N""

078EPE4<">9HE9R "P45"K9"4"7:9D7<"C==<"E5"4H9>CE5?"PECES95:d">E?6C"C="B=<ECEP4<">9H=<7CE=5N"#69" P=5:CEC7CE=5"458"C69"KE<<"=D">E?6C: "9@K=8F"C69":=PE4<"P=5C>4PC"5=CE=5"C64C"D>99"458":=H9>9E?5" E58EHE874<: "4>9"4K<9"C="D=>@"4":F:C9@"=D"?=H9>5@95C"D=>"C69@:9<H9:N" 3 EC6=7C"C69"M7B>9@9")=7>C" 89PE:E=5"E5" A"D=>"E5:C45P9A"EC"P=7<8"K9">94:=54K<F"4>?798"C64C"PECES95: "R=7<8"K9"95CEC<98"C=" 9:C4K & 6"59R "E5:CEC7CE=5:N"#69"89PE:E=5"E5" "B>=P7>9: "<9?ECE@4C9"4>>45?9@95C: "K9P47:9"EC" @ECE?4C9: "4?4E5:C"E5C9>9:C: "458"@4V9: ":7>9"C64C"B9=B<9"8=5dC"D99<"P=@B<9C9<F"4<E954C98"458"P45" 4PC74<<F"B4>CEPEB4C9"E5"C69"89@=P>4PF"C64C"C69F"64H9"9H9>F">E?6C"C="B4>CEPEB4C9"E5N" '=>9=H9>A"EC" 95D=>P98"C69"9T74<"B>=C9PCE=5"P<47:9"=D"C69"D=7>C995C6"4@958@95CA"C67: "B>=C9PCE5?"C69" P=5:CEC7CE=54<">>E5"CC7CE=54<">C"C9"C9"C=5:P<47:9"=D"C69"D=7>C995C6"4@958@95CA"C67: "B>=C9PCE5?"C69"

ME5P9"((78EPE4<">9HE9R"E: "C69"B>4PCEP9"R69>9KF"C69"((78EPE4>F"P45"899@"<4R:" 75P=5:CEC7CE=54<#"C69"()78EPE4>F"P45"4BB>=B>E4C9<F"E5C9>H959"R695"E58EHE874<"E5C9>9:C: "C>45:P958"

 $A"J \setminus L"$ 

078EPE4<">9HE9R "P45" @ECE?4C9"C69"845?9>"=D"E5C9>9:C: "B9>@94CE5?"C69"B=<ECEP4<"B>=P9:: "E5"4"R4F"C64C" =C69>"@945:"=D"P69PV:"458"K4<45P9:A": 7P6"4: "KEP4@9>4<E: @A"P455=C"K9P47:9"=D"EC: "75ET79"4KE<ECF" C="8E>9PC<F"E5C9>B>9C"C69"P=5:CEC7CE=5N"

",5"909>PE:E5?"(78EPE4<">9HE9RA"(78?9:"8E>9PC<F"894<"REC6"C69"8=P7@95C"C64C"9@K=8E9:"C69" B6E<=:=B6F"=D"1=PV9\\"+:"1=PV9"4>?79:A">E?6C:"4>9"C>45:D9>>98"D>=@"C69":C4C9"=D"54C7>9"C="C69"

## (="9T74 < "=BB = > C75ECF"458"4" > E?6C"4?4E5: C"8E: P>E@E54CE = 5A"B9>64B: N", C": 9P7 > 98"C64C" > E?6C"R6EP6"

:6=R:"7:"C64C"Q78EPE4<">9HE9R"P45"6998"<9?ECE@4PFN""

# ;+\*#",,,"

(G0%)#, (-M"+-&"\*%; 1,%M"

,D"R9"4>9"C="48H=P4C9"D=>"Q78EPE4<">9HE9R"4:"4"@945:"=D"B>=C9PCE5?"4?4E5:C"E58EHE874<"

B=<ECEP4<"89PE:E=5a@4VE5?A"Q78EPE4<"89PE:E=5:"4>9"@489"E5"C69"P=5C9OC"=D"Q78EPE4<"=4C6"458"Q78?9:" 4>9":7:P9BCEK<9"C="C69"B7K<EP"4PP=75C4KE<ECF"458"?959>4<"B>E5PEB<9"=D A"0945"04PT79:" \*=7::947d:"C9>@"D=>"4"B9>:=5d:"P=5P9>5"REC6"69>"=R5"B7K<EP":C458E5?N""

 $G9D \Rightarrow 9"4"(78?9"E:":R \Rightarrow 5"E5(="69)"B = :ECE=54":69"(4V9:"45"=4C6"=D"=DDEP9"C64("89:P>EK9:"(69"7589)<FE5?"(69@9:"=D"69)">=<94"@=>9":="C645"EC:"<=?E:CEP4<"B>=P987>9\" (59"=D"C69"B)>98=@E545C" (69@9:"E5"C69"(78EPE4<"=4C6"E:"C69"B=<ECEP4<"9T74<ECF"458"9T74<"K4:EP">E?6C:":9P7>98"KF"C69":=PE4<" P=5C>4PC"C>48ECE=5\" "#69"(78?9"9@K=8E9:"4":=@9R64C"*4R<:E45":95:9"=D"(7:CEP9"E5":R94>E5?"C=" b48@E5E:C9>"(7:CEP9"REC6=7C">9:B9PC"C="B9>:=5:"458"8="9T74<">E5:"458"8="9T74<">E5:"95:9"=D"(7:CEP9"E5":R94>E5?"C=" b48@E5E:C9>"(7:CEP9"REC6=7C">9:B9PC"C="B9>:=5:"458"8="9T74<">E5:"458"8="9T74<">E5:"9:C62"C="C69"B==>"458"C="C69">EECEP4<" P=5C>4PC"C>48ECE=5\" "#69"(78?9"9@K=8E9:"4":=@9R64C"*4R<:E45":95:9"=D"(7:CEP9"E5":R94>E5?"C=" b48@E5E:C9>"(7:CEP9"REC6=7C">9:B9PC"C="B9>:=5:"458"8="9T74<">E5:"9:E7:C69"B==>"458"C="C69"E9A<" 4DDE>@E5?"4"75EH9>:4<"K4:EP"D>998=@"458"P=5P9EHE5?"=D"9H9>F=59"4:"9T74<:\"#6E:"=4C6"P455=C" B=::EK<F"P=@B<9C9<F"?74>45C99"C64C"9H9>F"(78?9"RE<"4869>9"C="C6E:"P=5P9BCE=5"=D">E?6C:A"=>"40DE>@E5?"4"75EH9>:4<"K4:EP"D>998=@"458"P=5P9EHE5?"=D"9H9>F=59"4:"9T74<:\"#6E:"=4C6"P455=C" B=::EK<F"P=@B<9C9<F"?74>45C99"C64C"9H9>F"(78?9"RE<"4869>9"C="C6E:"P=5P9BCE=5"=D">E?078EPE4<"89PE:E=5a@4VE5?" E:"B=29P98P8"KF"45"=4C6"458"E58EHE874<"B=ECP4<"89PE:E=5a@4VE5?"E:"5=CA"C69"D94>"4?4E5:C"(78?9:" E:"B>9P9898"KF"45"=4C6"D94>"4?4E5:C"(78?9:" E5:9>CE5?"C69E)"B>=D995P9:"E:"D=@"B9=B<9"E5:9>CE5?"C69E"B>=0"9CF"E:"D>=@"B9=B<9"E5:9>CE5?"C69E>:A"$ 

" ,("P45":E@E<4>F"K9"4>?798"C64C"Q78?9:"4>9"8E:B=:98"C="488>9::"T79:CE=5:"E5"C9>@:"=D"4" Q78EPE4<"9C6=:"E5"4"R4F"C64C"4H9>4?9"PECES95:"4>9"5=C"K9P47:9"C69"<=P4CE=5:"E5"R6EP6"Q78?9:"458" PECES95:"9O9>PE:9"C69E>"B=<ECEP4<"89PE:E=5a@4VE5?"8EDD9>"D7584@95C4<<FN"#69>9"E:":CE<"4"K>=48" 9OB9PC4CE=5"4@=5?"E5:CEC7CE=5:"C64C"C69F"P4>>F"=7C"C69E>"89PE:E=5:">9:B=5:EK<FA"K7C"Q78?9:"4>9" :7KQ9PC"C="4"D=>@"=D"4PP=75C4KE<ECF"C64C"P455=C"K9"?959>4C98"HE4"9<9PC=>4<"B>9::7>9N" \* =7::947" 4PP=75C:"D=>":7P6"4"B695=@95=5"REC6"b Ac"6E:"C9>@"D=>"C69"b:9<DaE5C9>9:C98"8>EH9A" P=5P9>598"REC6"P=@B4>4CEH9":7PP9::"=>"D4E<7>9"4:"4":=PE4<"K9E5? g"eC64Cf"@4V9:"4"P95C>4<"E5C9>9:C"

<sup>&</sup>quot;b#6E:"D4@E<F"=D"E894:"a"9T74<"D>998=@A"9T74<">E?6C:A"458"9T74<"B=<ECEP4<"B4>CEPEB4CE=5"a"E:"P95C>4<" C="C69"54C7>4<">E?6C:"C69=>F"=D"C69":=PE4<"P=5C>4PC"C>48ECE=5"=D"1=PV9A" s 45CA"458"\*=7::947A"458"C=" C69"@=89>5"H9>:E=5"=D"C64C"C>48ECE=5A"\*4R<:0:"Q7:CEP9"4:"D4E>59::c"X/>99@45A"

JL"

\$=R9H9>A":7P6"4>?7@95C:"4<:="P>94C9"4":<EBB9>F":<=B9"K9P47:9"C69F"P45"E@B<F"C64C"Q78?9:" 4>9"9T7EBB98"C="@4V9"75E<4C9>4<"89PE:E=5:"4C"45F"?EH95"B9>E=8N",D"R9"B4E5C"C6E:"BEPC7>9"=D"Q78?9:" 4:"64HE5?"4":7B9>E=>":95:9"=D"89PE:E=5a@4VE5?"458"4KE<ECF"C="K9"75E5D<795P98"KF"C69E>"E58EHE874<" E5C9>9:C:A"R9"@E?6C"4:"R9<">9:9>H9"4<<"B=<ECEP4<"89PE:E=5:"C="C69@N"#67:A"45F"4>?7@95C"D=>"C69" :B9PE4<">=<9"=D"Q78?9:"@7:C"5=C"@4V9"C69E>">=<9"C==":B9PE4<"C="C69"B=E5C"C64C"C69F"4>9"4K<9"C=" )=7>CA"R6=:9"Q7:CEP9:":9>H9"<ED9<=5?"C9>@:"458"4>9"4BB=E5C98"KF"C69"B>9:E895CN"#69"P=7>C"@4V9:"4" 89PE:E=5"C64C"89DE5ECEH9<F"89C9>@E59:"C69"=7CP=@9"=D"C69"9<9PCE=5N"

,D"C69"P=7>("R9>9"C="@4V9":7P6"4"89PE:E=54"C69F"R=7<8"75E<4C9>4<<F"89PE89"4"B>9:E895CE4<" 9<9PCE=5"458"7589>@E59":9<Da>7<9\"M7P6"4"89PE:E=5"R=7<8"E5H4<E84C9"=59"=D"C69"D7584@95C4<"R4F:" :=H9>9E?5:"4>9"4K<9"C=">7<9"=H9>"C69@:9<H9: "E58EHE874<"B=<ECEP4<"89PE:E=5"@4VE5?N",5"@4E5C4E5E5?" 4":C4C9"R69>9"PECES95:"64H9"4":95:9"=D"H9:C98"D4EC6"E5"E5:CEC7CE=5:A"C>7:C"E5"C69"B>=P9::"=D" E5:CEC7CE=5:":6=7<8"5=C"K9"7589>@E598\"."8="5=C"488>9::'C6E:"5=CE=5"=D"C>7:C"=5"45"E58EHE874<":P4<9\" \*4C69>A"C6>=7?6"C69"<95:"=D"89@=P>4CEP":=H9>9E?5CF"458"C69"4KE</br> 4>?79"C64C"C6=:9"E5:CEC7CE=5:":6=7<8"K9"C>7:CR=>C6F"E5"=>89>"C=">9@4E5"<9?ECE@4C9"X458"C67:A"E5" 90E:C95P9ZN".D"4"M7B>9@9")=7>C"89PE89:"4"B>=P987>4<"E::79"4K=7C"45"9<9PCE=5"=>"45"E::79"4K=7C"C69" :7K:C45P9"=D"=7>"<9?4<">E?6C:A"C64C"R=7<8"7589>@E59"E58EHE874<"B=<ECEP4<"89PE:E=5"@4VE5?N",D"C69>9" R9>9":7P6"4":EC74CE=54"PECES95:"R=7<8"B<47:EK<F"64H9"4">E?6C"C=">9H=<CN"/=>@4<<F4"=59"64:"C69:9" 9T74<"B=<ECEP4<">E?60:A"K7("C69F"4>9"9DD9PCEH9<F"7589>@E598"K9P47:9"45=C69>"95CECF"E:"909>PE:E5?" C64C"B=<ECEP4<"89PE:E=5"@4VE5?"=5"C69E>"K964<DN",5"C69"1=PV945":95:9A"PECES95:d"4KE<ECF"C=" B4>CEPEB4C9"B=<ECEP4<<F"64:"K995":="7589>@E598"C64C"C69F"P=7<8"<9?ECE@4C9<F":4F"bC6E:"E:"5=C"4" 89@=P>4PF"45F@=>9\\c"ME5P9"C69F"64H9"4">E?6C"C="89C9>@E59"C69"E5:CEC7CE=5:"C64C"C69F"<EH9"7589>\\" C69F"64H9"4">E?6C"C=">9B<4P9"C6E:":F:C9@"=D"?=H9>5@95C"REC6"4"59RA"@=>9"B=<ECEP4<<F"9DD9PCEH9A" =591"

#### #69":4@9"D4PC=>:"C64C"@4V9"Q78EPE4<">9HE9

JI''

JJ"

3 4<8>=5N"/>99@45"<4784K<F":9P7>9:"9T74<"K4:EP">E?6C:"458"C69":=PE4<"P=5C4PC"E5C="6E:"P=5P9BCE=5" =D"89@=P>4PFN"\$=R9H9>A"D=>"C69"@=:C"B4>CA\*6E:"7589>:C458E5?"=D"B=<EEP4<F"<9?EE@4C9" 4>>45?9@95C:">=@45CEP4<<F"E?5=>9:"C69"4KE<ECF"=D"E5:CEC7CE=5:"C="?959>4C9"E<<PCE@4C9" 4>>45?9@95C:"D=@"REC6E5N"MB9PEDEP4<<FA"69"E?5=>9:"C69"4KE<ECF"=D"C69"(78EPE4>F"C="=H9>90C958"EC:" K=758:"458"C>45:?>9::">E?6C:N" 3 4<8>=5A"=5"C69"=C69>"6458A">9P=?5ES9:"C69"B=C95CE4<"D=>"C69" HE=<4CE=5"=D"9T74<"B=<ECEP4<'>E?6C:A"458">9P=?5ES9:"C69"5998"C64C"C69F"K9":9P7>98N"\$=R9H9>A" 3 4<8>=5"59?<9PC:"C="488>9::"C69"B=C95CE4<"D=>"45"E5:CEC7CE=5"C="C>45:?>9::"EC:"B4>CEPEB45C:d"K4:EP" >E?6C:"K9P47:9"69"8=9:"5=C"4PP=75C"D=>"C69"845?9>=7:"B=C95CE4<"=D"E5C9>9:C:"E5"909>PE:E5?"C69:9" 9T74<"B=<ECEP4<'>E?6C:N" - 9EC69>"/>99@45"5=>" 3 4<8>=5"B4E5:C4VE5?<F"488>9::9:"C69"D<EB":E89"=D"C69E>" 4>?7@95C:N"#6E:"9::4F"E:"D=75898"=5"C69"B6E<=:=B6EP4<"E894<"=D"<9?ECE@4PF"458"C69":=PE4<"P=5C>4PC]" 4>?7E5?"C64C"(78EPE4<'>9HE9R "P45"K9"4"7:9D7<'C==<"REC6E5"C64C"B6E<=:=B6EP4<'D>4@9R=>V"K7C":6=7<8"

,"8="5=C"=7CE59"6=R"?=H9>5@95C:":6=7<8"4PCEH9<F"B>=P7>9"<9?ECE@4C9"4>>45?9@95C:"=>" 6=R"@7P6"C="4PCEH9<F"95P=7>4?9"B=<ECEP4<"B4>CEPEB4CE=5N","@9>9<F"4>?79"C64C"?=H9>5@95C:"=7?6C" 5=C"C="4PCEH9<F"C>45:?>9::">E?6C:N"/=>"E5:C45P9A"C69F"=7?6C"C="5=C"K<4C45C<F"E5C9>D9>9"REC6"B=<ECEP4<" B4>CEPEB4CE=5A"4:"C64C"R=7<8"C>45:?>9::"9T74<"B=<ECEP4<">ECEP4<">E?6C:N"+<C6=7?6","B6>4:9"@45F"=D"C69:9" E::79:"E5"C9>@:"=D"C69":=PE4<"P=5C>4PC"C>48ECE=5"D>=@"C69":9H95C995C6"P95C7>FA"C69F"4>9">9<9H45C"C=" C69"P7>>95C"+@9>EP45"B=<ECEP4<"<458:P4B9N"#="E<<7:C>4C9"C6E:A"<9C"7:"B<4P9"C69"94><E9>"6FB=C69CEP4<" :P954>E="E5"C69"P=5C90C"C69"ILIL"B>9:E895CE4<"9<9PCE=5\_"

#69"M7B>9@9") =7>C"89PE89:"C64C"C95:"=D"C6=7:458:"=D"@4E<aE5"K4<<=C:"E5"H4>E=7:"P=75CE9:" E5";955:F<H45E4"C64C"4>>EH98"C6>99"84F:"4DC9>"9<9PCE=5"84F"4>9"C=="<4C9"C="K9"P=75C98N"#69" P458E84C9"C64C"=>E7E54<<F"R=5"C64C":C4C9"5=R"<=:9:A"CEBBE5?"C69":P4<9"=D"C69"?959>4<"9<9PCE=5"E5" D4H=>"=D"C69"<=:E5?"P458E84C9N"

J^"

### 3 (\* s M"),#%&"

6008:\_``RRRM4RMP=>59<4987`7:P=89`0900`IY`^\JN"+PP9::98"IJ" - =HN"ILILN" +<C67::9>A"1=7E:N" N" IN"98A" ![jjN" +>59:=5<sup>A</sup>" \* EP64>8<sup>N</sup>"b% ?4<EC4>E45<sup>E</sup>: @Nc" A"98EC98"KF" %8R4>8" - N"h4<C44"M7@@9>"IL!J4" ' 9C4B6F:EP:"\*9:94>P6"14K4"MC45D=>8" . 5EH9>:ECF4" IL!JN" A" 600B:\_``B<40=N:045D=>8N987`4>P6EH9:`:7@IL!J`950>E9:`9?4<E04>E45E:@`N" G9>C>4@A") 6>E:C=B69>N"b0945"04PT79:"\*=7::947Nc" 98EC98"KF"%8R4>8" - N"h4<C4A" 3 E5C9>"ILILA" ' 9C4B6F:EP:"\*9:94>P6"14KA"MC45D=>8" A" . 5EH9>:ECFA"ILILN"

6000B:\_``B<40=N:045D=>8N987`4>P6EH9:`RE5ILIL`950>E9:`>=7::947`N"

%8EC=>:A"\$E:C=>F"P=@N"b)69PV:"458"G4<45P9:Nc" A"

bIY".NMN")=89"1"^\J"a"(4C6:"=D"07:CEP9:"458"078?9:Nc"

60008: ``RRRN6E:C=>FNP=@`C=BEP:`7:a?=H9>5@950`P69PV:a458

A"

A"

 $\texttt{M}\,) + 1\,, + \texttt{A}" + - \,\#\,(\,\,\text{-}\,,\,\text{-}\,\texttt{A}"9\texttt{C}"4\texttt{A}"$ 

N" - %&a