





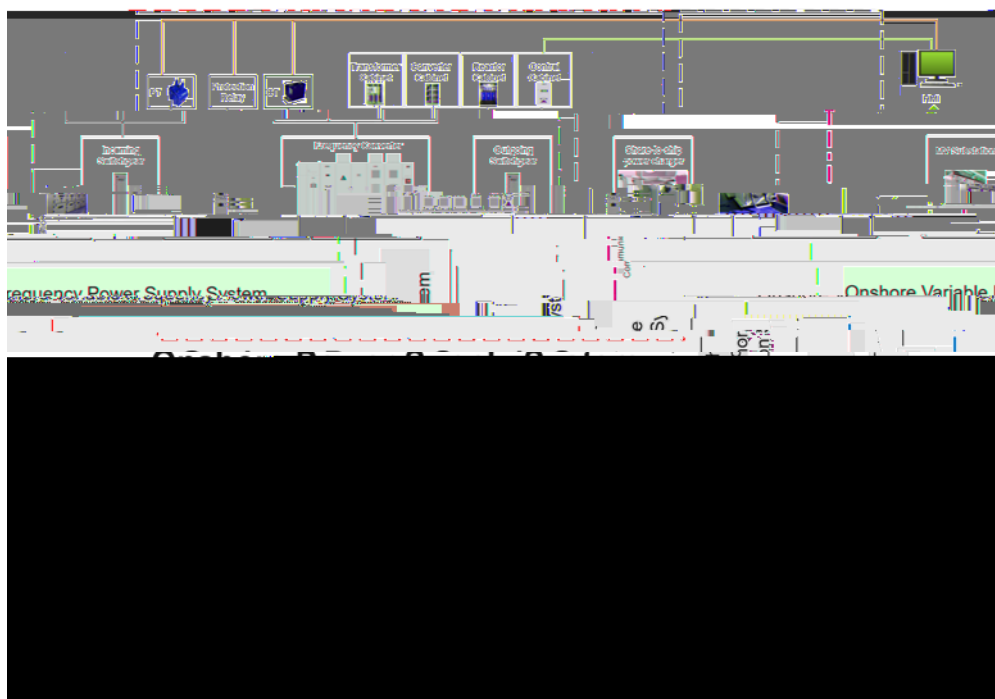
' ) & D W D O R J X H

2QVKRUH 3RZHU 6XSSO\ 6\VWHP

:LWK WKH GHYHORSERQQWIRFKVRSRLDQGMSSHQJHMGVHRQXPEHU  
ODUJH WRQQDJH VHLGSVDSLVGDQFDQGVWVHH SRZHU RIVRQSQR LQVWH  
RI VKLS JHQHUDWRWVFGDOLQDQV KHHHBRVH YHDOJH HVGDFOH DLU DQG  
SROOXWLRQ FDXVHG E\ WKH FRPEXVWHPRQVRIRQHSDWRWQHDQDQDFM  
WKH XVH RI RQVKRUH SRZHU VXSSO\HLVXDUVRQDVWQIQIXWXB RUHG  
WUHOGV

&RPSRVLWLRQ RI 2QVKRUH 3RZHU 6XSSO\ 6

7KH RQVKRUH SRZHU VXSISDSRWVWHR WKURHQVSDUWYDWKDEOH  
IUHTXHQF\ SRZHU VXSISOKLS\WVRHFKRUHWHFRQHQFQWVKH WMLSERDU  
SRZHU UHFHLYLQJ V\WVHP DV VKRZQ RIQ+LJXUROWDKH \$QFKRW  
3RZHU 6XSSO\ 6\WVHP



) L J X U H    \$ U F K L W H F O W X D J H R 2 I Q + M K J R U Y H R 3 R Z H P U    6 X S S O \    6 \ V W

Onshore variable frequency power supply system ,W LV PDLQO\ FRPSRVHG RI KLJK YDULDEOH IUHTXHQF\ SRZHU WRSKLOSDSRZHUFRQDUFWLQJ FDEOH

Ship-to-shore connection system , W L V F R P S R V H I G O R I S F O X E O D H Q G Q F R Q Q E O H  
H W F

Shipboard power receiving system: ,W LV FRPSRVHG RI VKLSERDUG WUDQVIR  
SRZHU UHFHLYLOJ FDSRZHUWGVKWSIERDUGFRODDEWOLQW DDEOH H



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0DLQ )XQFWLRQV

7KH RQVKRUH SRZHU LVXSSOUDWVW HPRQLSWRULHQFWIFRQWRUHRWUHL  
ELOOLQJ DQG HTXLSFDQGWPHDQMDXWFKHQWIKWY RROWDJH RQVKRU  
SRZHU FRQQHFWLRQWKUWXUJWQWQLEQKFRPELQDWLRQ

3RZHU FRQY&RQYRQW WKH YROWDSHUWIDBQXHQRGH SRZHU JU  
WKH YROWDJHUHTXHTXHQE\ VKLS

|           |              |
|-----------|--------------|
| 9ROWDJH 9 | )UHTXHQF\ +] |
|           |              |
|           |              |
|           |              |
|           |              |

7DEOH 9ROWDJH RXWSTXMRQ\RFQVKRUHQYDSRDEOHVXS\$D\  
V\VWHP

5HJDUGLQJ WKHKHUXROWDQHS IMHTXHIQFS UHTQRLWPHGOB\ N9  
+] +]

6KLS &RQQHFWLRQ 0HWKRG

High-voltage ship connection: 7KH QXPEHU RI FDBOMKHF&RQHFWLRQ LV V  
DQG LW LV VXLWDEOH IRU ODUJH FDSDFLW\

Low-voltage ship connection 7KH QXPEHU RIODDBBHWKM FRQQHFWLRQ  
FRPSOH[ DQG HWRUWVWXLWDEDSDFLW\  
2QVKRUH SRZHU VXSSO\$O\SRZHUFRWKRWSJH RUJ&RYZYROWD  
XVXDOO\ WKH V&RQZGU&BHRORZHG

:KHQ SRZHU FDSDFLW\ UHTXLUHG LV OSRZHWVWXS\$SON9\$  
FRXOG EH XVHG

:KHQ SRZHU FDSDFLW\ UHTXLUHG LV EHWKHYRQWDN9\$ DQO  
SRZHU VXSSO\ LV VXJJHVWHG

:KHQ SRZHU FDSDFLW\ UHTXLUHG LV JUWDDMH\$SRV&KQ  
VXSSO\ VKRXOG EH XVHG

:KHQ WKH ORZ YROWDJH SRZHU VXSSO\ FRWKR\$ WRDGR\$MH  
FRQQHFWLRQ FDEOKHV LROXDUJRI DQ&BDEH HZK&HIO ZLVOO RFFX  
D ORW RI VSDFH )RU WKH VKLS RI V&D&B SURQQL&H WKM EDB  
DQG FDEOH UHHO E\ ODQG VLGH

:KHQ WKH KLJK YROWDJH SRZHUWK&SWDQF&FDEOH UHHO ZLOO  
EH XVXDOO\ VXS\$O\HGH&FVRUGLQJ SRD&F&H&QW\$UQD&Q&QV  
ZLOO HVWDEOLVK\ SRHQSRZQUWKXS&FN IURQW

6KRUH WR VKLS 3RZHU&RQ&B&F&H&Q&ZGWKR\$W VKLS¶V SRZHU  
&RQQHFWLRQ ZLWK VKLS¶V SRZHU UXQQLQJ

Connection without ship's power running: :KHQ WKH VKLS HQWHUV WKH SRUW



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DOO WKH HHTXLSVPHIQVD RQQV KHWVRLS W QHH UDVSV W JWHK HQ FRQQHF  
WKH RQVKRUH SRZH W V X V X O I Q R Q G W L F D D K L T X V S H P O H Q W U W U H D  
WKH VZLWFKLQJ I J R P H W B W R M K M S R V W K H S S Q V K R U H Q S R I Z H U W V I X S  
O H D Y H V S R U W L W H V K B Q O U G V E H T U R I S Q B D W

Connection with ship's power running: ,W LV DOVR FDOOHG VIQFKURQLJDW  
PRGH LQ ZKLFK W H C H V K L X S L B D H Q W U V Q R V U Q B W B S I H H F D W H I G R Q D Q G  
K D V V L J Q L I L F D Q W L P S Q H W W D Q W R H U W K W Q L W B B M K K S S P H Q W  
& R Q Q H F W L R Q Z L W K V K L S I V S R Z H U U X Q V K L Q U H P S R Z H U V V W K W H W U  
D Q G L W S U R Y L G H V W K H T X L F N S U R W R E W R I R Q Q W R R I X I S B D H W  
V I V W H P

0 H W H U L Q J D Q V P H L D V V Q W K H U H T X L S H P H I Q W L R Q I P K J W H U L Q J D Q G  
R I W K H S R U W H O H F W U L F H Q H U J \

5 H D O W L P H O R V Q L Z L R O L Q R Q L W I R U H D O D O W W K H B B D B R W H S R Z H U V  
V I V W H P \$ O O W K H D Q H D D X O W H L Q D R W D D W B R Q G E Q E C H P R Q  
, Q W H J U D W H G \$ Q B Q W K R O I X Q F W L R Q V R I W K H V I V W H P D U H F R  
G H G L F D W H G F R Q W U R O V I V W H P D Q G W K W R X X I K W X K H W B E S D Q H  
E \ R S W L F D O I L E H U W B L D D Q V K H Q G X H V B Q L Y D U F D Q E O B I X I W H H T X H Q  
S R Z H U V X S S O \ H T X L S P H Q W



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3URGXF 2YHUYLHZ

2QVKRUH 9DULDEOH )UHTXHQF\ 3RZHU 6XSS

%DVHG RQ LWV RZQ PDWXUH DQG UHOLXDEOH WILFKROWDJH  
'RQJIDQJ (OHFWURQLVVLQJHS/WGGHQWOPDQYDWRSHBGDQGH KLJ  
YROWDJH RQVKRUH YDULDEOH IUHTXHQFRUSRZHU RQVSKRUHVSRZH  
VXSSO\ VVWHP DQGHGDDQHRQWDEROLW SRZHUOLXS O\ SURGX

7KH RQVKRUH YDULDEOH VXSSOHQVSRZ FRQYHUW WKH



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& R P S R Q H Q W ) X Q F W L R Q



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|                      |                                                                                                                                                                                                                  |  |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| &RPPXQLFDWLRQ        | 56 (WKHUQHW                                                                                                                                                                                                      |  |
| 3URWHFWLRQ )XQFWLRQV | \$XWRPDWLF FXUUHQW OLPLWLQJ RY<br>PRWRU RYHUORDGJRYHUQGHUYROW<br>LQVWDQWDQHRXV SRZHU IDLOXUH L<br>SKDVH ORVV FRROLQJ IDQ IDLOXUH<br>IDXOW EISDVV SURWHFWLRQ WUDQ<br>RXWSXW JURXQGLQJRXWSXWFRQGD<br>VKRUW FLUFXLW |  |
| \$ODUP )XQFWLRQV     | ,QSXW DQG RXWSXW RYHUORDG F<br>RYHUKHDWLQJ ORLW SXWSXW VLQJ<br>SKDVH JURXQGLQJSXWSXWRWDJH D<br>FXUUHQW XQEDODQFH LQSXW<br>GLVFRQQHFWLRQWFKRRWUDQZIRUPHU<br>RYHUKHDWLQJ FRROLQJ IDQ IDLOXUH                       |  |



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FDQ EH UHDOLJHG

'LVSOD\ IXQDQLQVS,WD\ WKH IUHTXHQFWKYRHOWSKDHF XQED OD  
DFWLYH SRZHU UHDFWLYH SRZHU SRZHUWIDHVRXWSXW SRZH  
VXSSO\ DQG GLVSDQ\PHDVWUWHQW IRIQHDFWLDQGSBZBFWLYH  
SRZHU HQHUJ\

3KDVH VHTXHGFH GHXWFWHLQW DQB SBZHUVIRKXHSQFWH SKDDV  
DXWRPDWLF DQGMPXDPHQW PRGHV

+DUGZLUHG LQWHUIDFMD&WPPDQBS RQFVHWWBSG HPHUJH  
2SHUDWLRQDO SWZMXWHDGQDOXQQWQJ IDWQWSHVXWGRZQ  
7KH SRZHU VXSSO\ TXZLOLWUHFQPSDQM VWDQGDUGV

,W KDV SURWHFWKRDVIXQFWDRQDQFKXKQW FLUFXLW RYHUC  
RXWSXW XQGHUYROWDWDJHLQBXWUXQGMDYIRQSYVHUKHDXHLQF\  
UDQJH RYHUFXUUHQWHSKDLRHQORXQLVSDFRQURWWFWLREQQRLXW





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2QVKRUH 3RZHU 6XSSO\ 6ROXWLRQ

6ROXWLRQ &DWHJRULHV

9DULDEOH )UHTXHQF\ 6ROXWLRQ

High voltage variable frequency solution: ,W LV VXLWDEOH IRU VKLSV ZLWK ODUJ

Low voltage variable frequency solution: ,W LV VXLWDEOH IRU KRPPDLOS FDSDFLW\

\*ULG )UHTXHQF\ 6ROXWLRQ

High voltage grid frequency solution: ,W LV VXLWDEOH IRU DUKLS FDSDFLW\

Low voltage grid frequency solution: ,W LV VXLWDEOH IRU KRPPDLOS FDSDFLW\

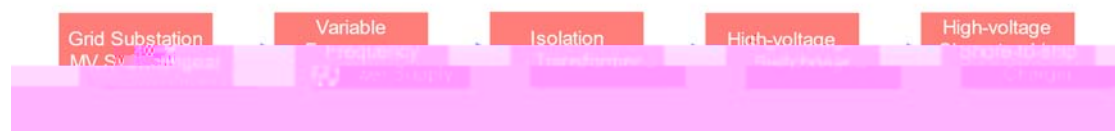
6KLS &RQQHFWLRQ 0HWKRG

High-voltage ship connection: 7KHUH LV D VWHS GRZQ WUDQVIRUPHU RQ VKLS  
FDEOHV WKH FRQQHFWLRQ RYHU SHZHU FVXSHUWLQJ WKH 7KLS  
VROXWLRQ LV VXLWDEOH IRU WKH FDSDFLW\

Low-voltage ship connection: 7KHUH LV QR VWHS GRZQ WUDQVIRUPHU RQ VKLS  
FDEOHV WKH FRQQHFWLRQ RYHU SHZHU FVXSHUWLQJ WKH 7KLS  
VROXWLRQ LV VXLWDEOH IRU WKH FDSDFLW\

%DVLF 6ROXWLRQV

+LJK 9ROWDJH 6KLS &RQQHFWLRQ DQG HIQFK\ 9ROWDJH 9DULDEOH  
6XSSO\ 6ROXWLRQ  
,W LV VXLWDEOH IRU WKH FDSDFLW\ IRU WKH GRZQWIRUPHU RQ





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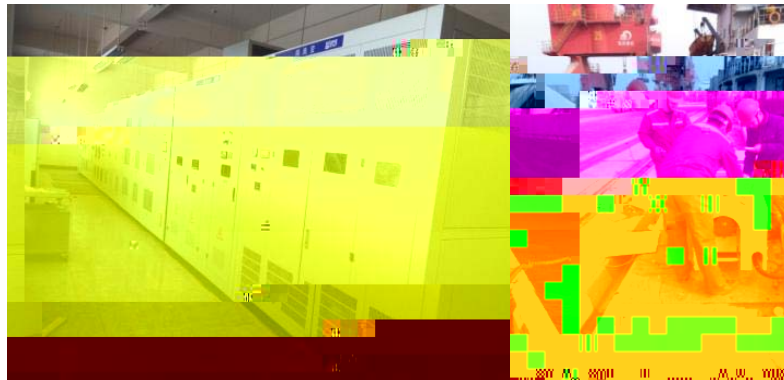
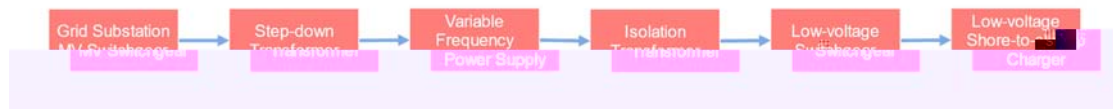
+LJK 9ROWDJH 6KLSQ&RQQHFWURQXHQF\ 3RZOXWLRSSO\  
,W LV VXLWDEOH OBUJMKFDSDESZLWQCSGRZQHWLWDDQVIRUPHU RQ

/RZ 9ROWDJH 6D{T• WhU...pp6RQQHF{T•`Àp@µl°0 HY090đ%TIĐp@

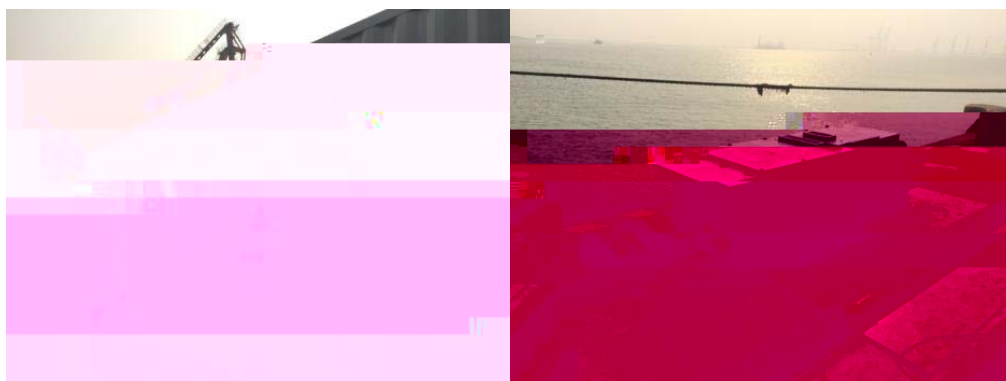


' ) & D W D O R J X H

/ R Z 9 R O W D J H 6 K L S & R Q Q H F W L R Q D Q G / R Z F Y R Q W H D J H 9 D U L D  
 6 X S S O \ 6 R O X W L R Q  
 , W L V V X L W D E O K M P U O W K H F V S K D S L W W H W R Q V L Q R S H W S R I Z H U V X S S O  
 F R P H V I U R P W K H V X E H W D Q V L R Q H 9 H V L V D Q R I R W F I S U G R Q Q V W L S



, W L V V X L W D E O K M P U O W K H F V S K D S L W W H W R Q V L Q R S H W S R I Z H U V X S S O  
 F R P H V I U R P W K H V X E H W D Q V L R Q H 9 H V L V D Q R I R W F I S U G R Q Q V W L S





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‡@pSpW10ChP f V0VpK 0 0 w'V8'M 8 V m !ò V"• C



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5HIHUUHQFHV

2QVKRUH 3RZHU 5HIHUUHQFHV

|                              |                    |              |           |
|------------------------------|--------------------|--------------|-----------|
| 3URMHFW                      | 3RZHU &RQYHUVLR    | 6ROXWK&DSDFI | 4XDQWLW\  |
| <DQWDL :HV*09 6'7) 9)36 687) | 9)                 | 09\$         | 2636      |
| :DQKXD 7HU\+96&O             |                    |              | ZLWK 6 &  |
| 3HQJODL 3R                   | *09 9)36 ,67) +96& | 9)           | 09\$ 2636 |
|                              |                    |              | ZLWK 6 &  |
|                              | *09 9)36 ,67) +96& | 9)           | 09\$ 2636 |
|                              |                    |              | ZLWK 6 &  |
| <DQWDL 3RU                   | *09 7) +96&        | *)           | 09\$ 2636 |
| 3DVVHQJHU                    |                    |              | ZLWK 6 &  |
| 7HUPLQDO                     |                    |              |           |
| /RQJNRX                      | *09 7) /96&        | *)           | N9\$ 2636 |
| 3KDVH                        |                    |              | ZLWK 6 &  |
| /RQJNRX                      | *09 7) +96&        | *)           | 09\$ 2636 |
| 3KDVH                        |                    |              | ZLWK 6 &  |
| :HLIDQJ 3RU                  | *09 7) +96&        | *) 9)        | 09\$ 2636 |
|                              | *09 9)36 6'7) /96& |              | ZLWK 6 &  |
|                              |                    |              | 2636      |
|                              |                    |              | ZLWK 6 &  |
| <DQWDL                       | *09 6'7) 9)36 687) | 9)           | 09\$ 2636 |
| &RQWDLQHU                    | +96&               |              | ZLWK 6 &  |
| 7HUPLQDO                     | *09 6'7) 9)36 ,67) |              | 6SDUH     |
|                              | /96&               |              | +96&      |
| <DQWDL                       | *09 9)36 ,67) +96& | 9)           | 09\$ 2636 |
| ,QWHUQDWLRQDO                |                    |              | ZLWK 6 &  |
| &RQWDLQHU                    |                    |              |           |
| 7HUPLQDO                     |                    |              |           |
| <DQWDL                       | *09 9)36 ,67) +96& | 9)           | 09\$ 2636 |
| 7RQJVDQ 7HUPLQDO             |                    |              | ZLWK 6 &  |
| =KDQJJKRX                    | *09 9)36 ,67) +96& | 9)           | 09\$ 2636 |
| 0HUFKDQWV 3RUW               |                    |              | ZLWK 6 &  |
| 1LQJER 3RU                   | *09 9)36 ,67) +96& | 9)           | 09\$ 2636 |
| 7HUPLQDO                     |                    |              | ZLWK 6 &  |
| +XDQJKXD 3                   | *09 9)36 ,67) +96& | 9)           | 09\$ 2636 |
|                              |                    |              | ZLWK 6 &  |
|                              | *09 6'7) 9)36 ,67) | 9)           | N9\$ 2636 |
|                              | /96&               |              | ZLWK 6 &  |
| <DQWDL :HV*09 6'7) 9)36 687) | 9)                 | 09\$         | 2636      |
| 2UH 7HUPLQDO                 | +96&               |              | ZLWK 6 &  |
| :HLKDL 3RU                   | *09 7) +96&        | *)           | 09\$ 2636 |



') &DWDORJXH

|                                                                                                                                                                                                                              |             |    |      |                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----|------|------------------|
| 5R 3D VVH QJHU<br>7HUPLQDO                                                                                                                                                                                                   |             |    | ZLWK | 6 &              |
| /DLJKRX 3R                                                                                                                                                                                                                   | *09 7) /96& | *) | 09\$ | 2636<br>ZLWK 6 & |
| 1RWH09 *ULG 09 7) 7UDQVIRUPHU 6'7) 6W,03) GRZQ 7UD<br>,VRODWLRQ 7UDQVIRUPHU 7000) VIRUPH RUH2332H006XSSO\<br>+96& +LJK YROWDJH 6KRUH WR VKLS &KDUJHU WR/96&LS/RZ Y<br>&KDUJHU 6& 6KRUH WR VKLS &KDUJHU *9) LG9DUHDXHF) UHTXH |             |    |      |                  |

6KLSERDUG 3RZHU 5HFHLYLQJ 6\ VWHP  
5HIHUHQFHV

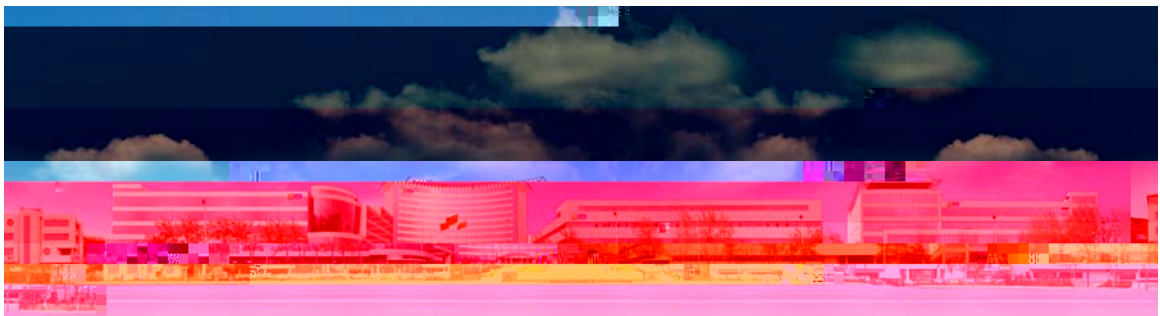
|                  |                              |              |                                                                                                                     |     |
|------------------|------------------------------|--------------|---------------------------------------------------------------------------------------------------------------------|-----|
| 3URMHFW          | 3RZHU<br>5HFHLYLQJ<br>0HWKRG | &DSDFLW4XDQW | 6KLS 1DPH                                                                                                           |     |
| %RKDL<br><DQWDL  | ) +LJK YRO' 09\$H            |              | %RKDL 3HDUO<br>%RKDL *UHHQ 3HDUO<br>%RKDL &U\ VWDO 3HUDO<br>%RKDL 'LDPRQG 3HDUO<br>%RKDL \$JDWH 3HDUO<br>6KHQJVKHQJ |     |
| %RKDL<br>:HLKDL  | ) +LJK YRO' 09\$H            |              | %RKDL +HQJVKHQJ                                                                                                     | HQJ |
| %RKDL<br>/RQJNRX | ) +LJK YRO' 09\$H            |              | %RKDL +HQJGD<br>%RKDL +HQJWRQJ                                                                                      | QJ  |

'RQJIDQJ (OHFWURQLFV ,QWHUQDWLRQDO (QJLQHULQJ  
'RQJIDQJ (OHFWURQLFV &R /WG  
\$GGUHV V 1R -LFKDDQJ 5RDQGGRQQWURQDQFH 3 5 &KL  
7HO

)D[

(PD [LDGI#GRQJIDQJ\\_FKLQD\\_FRP](#)

:HEVL [WWW.S\\_ZZZ\\_GRQJIDQJ\\_FKLQD\\_FRP\\_HQ](#)



7+( ,1)250\$7,21 &217\$,1(' ,1 7+,6 '2&80(17 ,6 7+( 35231(5)54\*2I/('&7521,&6 ,17(51\$7,21\$/  
(1\*,1((5,1\* &2 /7' \$// 5,\*+76 5(6(59('