

Title: **Functional Specification
for Reactive Power Control**

Ref. **730/CF0136/T06/
DRM001C.SPC**

Original A **12.5.97**

Situation	Visakhapatnam		Customer	POWERGRID		Approved	BAR
Issue	^a 8.5.98	^c 14.4.99	^a	^t	^f	^d	
Approved	BTB	<i>ML</i>					

demand is executed (PVL) shall be applied to both the "Convertor Surplus" and "Convertor Deficit" limits ($CSO_{e/s}$ and $CDO_{e/s}$). If a new target V_{ac} is set, then a new offset shall be derived based on the V_{ac} at the time the new ACVCM demand is executed. RPC shall inform the Mimic of the achieved "target" if it is different from the demanded "target".

- d) When ACVCM is de-selected, RPC shall not accept further target V_{ac} from the Mimic. RPC shall instead transfer the derived offset to RPEM and send a signal to the Mimic to show the presently achieved offset. Therefore, de-selecting from ACVCM will result in operation in RPEM.
- e) If ACVCM is selected, RPC shall send signals to the Mimic to indicate the achieved equivalent RPEM offsets.
- f) The total offset(s) due to RPEM or ACVCM to be applied to the "Surplus Limit" and the "Deficit Limit" shall not exceed 300Mvar.
- g) RPC shall control the var exported to the ac systems following the demanded offsets in so far as the inherent capability of the convertors allows. RPC shall indicate the achieved offsets to the Mimic if the demanded offsets can not be met. The convertor absorption under various operating conditions is shown in figure 16.
- h) If the operating condition has subsequently changed such that the capability of the convertors to exert var control is restricted, then RPC shall adjust the achieved offset(s) automatically to avoid exceeding the inherent capability of the convertors. RPC shall send the new achieved offset(s) to the Mimic.
- i) When operating in ACVCM or RPEM, the harmonic performance monitor (clause 7.4.5) shall remain active over the entire power range to either add extra filters or adjust the var range. The threshold of the harmonic performance monitor shall be adjustable from the default values given in clause 7.4.5.
- j) When operating in ACVCM or RPEM, all filters/reactors on each ac system shall be assumed to be operative (unless SPM indicates otherwise).
- k) If RPEM/ACVCM is only applied to one side, then the offsets to be applied to the "Surplus Limit" and the "Deficit Limit" shall be limited based solely on the equipment capabilities of that side.

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- l) When both sides are operating in RP EM/ACVCM, the operator demanded offsets shall be limited by taking into account the equipment capabilities of both sides and the interaction effect between the two sides. The capability of the convertors to absorb var under various conditions, without considering the var generated by the filters, is shown in Figure 16. If the operator demanded offset to the "Surplus Limit" is negative on one side and is positive on the other, RPC shall try to meet the negative offset first and then use the remaining capacity to try to meet the positive offset.
- m) In the event of a conflict between positive and negative convertor surplus limits, RPC shall ensure that the var exported to the ac system, which has a more negative accepted offset applied to its "Surplus Limit", is always within the stipulated limits. The var exported to the other ac system shall be allowed to exceed the "Surplus Limit".
- n) The maximum acceptable negative offset to the "Surplus Limit" on both sides shall be relaxed when the ac system voltage on either side exceeds 420kV. The relaxation is only required when power transfer is less than 30% of nominal.
- o) Pre/Post-Conditioning process for filter switching shall be carried out as indicated in clause 7.5.1.
- p) All other control loops eg. open loop, closed loop shall remain active unless otherwise specified.

7.20.3.1 If the operator asks for convertor deficit offsets which are positive on both sides ($CDO_e > 0$, $CDO_i > 0$), then under this condition, RPC will limit these offsets independently based on the total filter var available on each side.

The Total Filter Var Available (TFVA) is given as:

$$TFVA_{e/s} =$$

(Number of filters available) x (Adjustment to positive offset as per Figure 18) - $[V_o VA] - [(Number of reactors unable to de-energise) x (Adjustment to positive offset as per Figure 21)]$

Equation 33

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The logic to determine whether the requested offsets are accepted is:

IF $TFVA_{e/s} \geq CDO_{e/s} + \text{Default Deficit Limit (East/South)}$

THEN $ACDO_{e/s} = CDO_{e/s}$

$ACSO_{e/s} = CSO_{e/s}$ (see item (a), 7.20.2)

ELSE $ACDO_{e/s} = TFVA_{e/s} - \text{Default Deficit Limit (East/South)}$

$ACSO_{e/s} = CSO_{e/s}$ (see item (a), 7.20.2)

IF $TFVA_{e/s} < \text{Default Deficit Limit (East/South)}$

THEN $ACDO_{e/s} = 0$

$ACSO_{e/s} = CSO_{e/s}$ (see item (a), 7.20.2)

Once the accepted offsets ($ACDO_{e/s}$, $ACSO_{e/s}$) have been calculated and displayed on the Mimic, RPC shall continuously monitor $TFVA_{e/s}$ to ensure that the accepted offsets ($ACDO_{e/s}$, $ACSO_{e/s}$) are still achievable. If conditions change which restrict the ability of the filters to provide vars, RPC shall automatically adjust the accepted offsets and send the new achieved offsets to the Mimic.

While ($ACDO_{e/s} > 0$)

IF ($TFVA_{e/s} < ACDO_{e/s} + \text{Default Deficit Limit (East/South)}$)

THEN $ACDO_{e/s} = TFVA_{e/s} - \text{Default Deficit Limit (East/South)}$

$ACSO_{e/s} = CSO_{e/s}$ (see item (a), 7.20.2)

IF ($TFVA_{e/s} < \text{Default Deficit Limit (East/South)}$)

THEN $ACDO_{e/s} = 0$

$ACSO_{e/s} = CSO_{e/s}$ (see item (a), 7.20.2)

Update Mimic with new achieved offsets (East/South)

- 7.20.3.2 If the operator asks for convertor surplus limits which are negative at both sides ($CSO_e < 0$, $CSO_s < 0$), then under this condition, RPC can limit these offsets independently based on the maximum absorption capability of the convertors on each side.

The maximum absorption capability of the convertors (MACC) is given as:

$MACC_{e/s} = (\text{Minimum Number of Filters required for RPEM as per Table 4 (or Table 2, see clause 7.20.6, 7.20.7)}) \times (\text{Adjustment to Negative offset as per Figure 17}) + (\text{Maximum Absorption "RPM" as per Figure 16 (or Figure 19, see clause 7.20.3.4)}) - [(\text{Number of reactors available to energise}) \times (\text{Adjustment to negative$

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offset as per Figure 20)].

Equation 34

The logic to determine whether the requested offsets are accepted is:

IF $MACC_{e/s} \leq CSO_{e/s} + \text{Default Surplus Limit (East/South)}$
 THEN $ACSO_{e/s} = CSO_{e/s}$
 $ACDO_{e/s} = CDO_{e/s}$ (see item (a), 7.20.2)
 ELSE $ACSO_{e/s} = MACC_{e/s} - \text{Default Surplus Limit (East/South)}$
 $ACDO_{e/s} = CDO_{e/s}$ (see item (a), 7.20.2)

IF $MACC_{e/s} > \text{Default Surplus Limit (East/South)}$
 THEN $ACSO_{e/s} = 0$
 $ACDO_{e/s} = CDO_{e/s}$ (see item (a), 7.20.2)

Once the accepted offsets ($ACDO_{e/s}$, $ACSO_{e/s}$) have been calculated and displayed on the Mimic, RPC shall continuously monitor $MACC_{e/s}$ to ensure that the accepted offsets ($ACDO_{e/s}$, $ACSO_{e/s}$) are still achievable. If conditions change which retard the ability of the Convertors to provide vars, RPC shall automatically adjust the accepted offsets and send the new achieved offsets to the Mimic.

While $(ACSO_{e/s} < 0)$
 IF $(MACC_{e/s} > ACSO_{e/s} + \text{Default Surplus Limit (East/South)})$
 THEN $ACSO_{e/s} = MACC_{e/s} - \text{Default Surplus Limit (East/South)}$
 $ACDO_{e/s} = CDO_{e/s}$ (see item (a), 7.20.2)

IF $(MACC_{e/s} > \text{Default Surplus Limit (East/South)})$
 THEN $ACSO_{e/s} = 0$
 $ACDO_{e/s} = CDO_{e/s}$ (see item (a), 7.20.2)

Update Mimic with new achieved offsets (East/South)

7.20.3.3 While the operator asks for ($CDO_e > 0$, $CSO_e < 0$ or $CSO_e < 0$, $CDO_e > 0$), then under this condition, RPC may not be able to limit these offsets independently. Under this condition, RPC shall initially limit the NEGATIVE applied offset of one side as follows:

IF $MACC_{e/s} \leq CSO_{e/s} + \text{Default Surplus Limit (East/South)}$
 THEN $ACSO_{e/s} = CSO_{e/s}$

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ELSE $ACDO_{e/s} = CDO_{e/s}$ (see item (a), 7.20.2)
 $ACSO_{e/s} = MACC_{e/s} - \text{Default Surplus Limit (East/South)}$
 $ACDO_{e/s} = CDO_{e/s}$ (see item (a), 7.20.2)

IF $MACC_{e/s} > \text{Default Surplus Limit (East/South)}$
 THEN $ACSO_{e/s} = 0$
 $ACDO_{e/s} = CDO_{e/s}$ (see item (a), 7.20.2)

RPC shall then limit the POSITIVE applied offset based on the constraint imposed by the accepted negative offset. This is achieved by first calculating the absorption of the convertor needed to meet the negative offset. Once this absorption figure is known, the excess var that can be applied to the other side is calculated. This excess var figure then determines whether the POSITIVE offset limit can be accepted. The equations necessary to achieve this are:

For the side with the NEGATIVE offset.

Increase in convertor absorption to meet the accepted negative offset (ICA) =
 (Minimum Number of filters required for RPEM as per Table 4) x
 (Adjustment to negative offset as per Figure 17) - (Default "Surplus Limit" +
 Accepted negative offset to the "Surplus Limit") - (Number of Line charging
 reactors in service, applicable to eastern region only) x (Reactor Negative
 adjustment as per Figure 20 applicable to eastern region only) - [V_oVA]

Equation 35

For the side with the POSITIVE offset.

Excess var available for side with positive offset (EVA) = (Number of filters
 available) x (Adjustment to positive offset as per Figure 18) - (ICA) - (Number of
 line charging reactors in service, applicable to eastern region only) x (Reactor
 positive adjustment as per Figure 21, applicable to eastern region only) - [V_oVA]

Equation 36

The logic to determine whether the requested positive offset is accepted is:

IF $EVA_{e/s} \geq CDO_{e/s} + \text{Default Deficit Limit (East/South)}$
 THEN $ACDO_{e/s} = CDO_{e/s}$

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ELSE $ACSO_{e/s} = CSO_{e/s}$ (see item (a), 7.20.2)
 $ACDO_{e/s} = EVA_{e/s}$ - Default Deficit Limit (East/South)
 $ACSO_{e/s} = CSO_{e/s}$ (see item (a), 7.20.2)

IF $EVA_{e/s} < \text{Default Deficit Limit (East/South)}$
 THEN $ACDO_{e/s} = 0$
 $ACSO_{e/s} = CSO_{e/s}$ (see item (a), 7.20.2)

Once the accepted offsets ($ACDO_{e/s}$, $ACSO_{e/s}$) have been calculated and displayed on the Mimic, RPC shall continuously monitor $MACC_{e/s}$ and $EVA_{e/s}$ to ensure that the accepted offsets ($ACDO_{e/s}$, $ACSO_{e/s}$) are still achievable. If conditions change which retard the ability of the convertors/filters to meet the offsets, RPC shall automatically adjust the accepted offsets and send the new achieved offsets to the Mimic.

For the side with the NEGATIVE offset

While $(ACSO_{e/s} < 0)$
 IF $(MACC_{e/s} > ACSO_{e/s} + \text{Default Surplus Limit (East/South)})$
 THEN $ACSO_{e/s} = MACC_{e/s} - \text{Default Surplus Limit (East/South)}$
 $ACDO_{e/s} = CDO_{e/s}$ (see item (a), 7.20.2)
 IF $(MACC_{e/s} > \text{Default Surplus Limit (East/South)})$
 THEN $ACSO_{e/s} = 0$
 $ACDO_{e/s} = CDO_{e/s}$ (see item (a), 7.20.2)

Update ICA in Equation 35
 Update Mimic of new achieved offsets (East/South)

For the side with the POSITIVE offset

While $(ACDO_{e/s} > 0)$
 IF $(EVA_{e/s} < ACDO_{e/s} + \text{Default Deficit Linfit (East/South)})$
 THEN $ACDO_{e/s} = EVA_{e/s} - \text{Default Deficit Limit (East/South)}$
 $ACSO_{e/s} = CSO_{e/s}$ (see item (a), 7.20.2)

IF $(EVA_{e/s} < \text{Default Deficit Limit (East/South)})$
 THEN $ACDO_{e/s} = 0$
 $ACSO_{e/s} = CSO_{e/s}$ (see item (a), 7.20.2)

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Update Mimic with new achieved offsets (East/South)

7.20.3.4 The Guaranteed Maximum Absorption on both sides shall be relaxed when the ac system voltage on either side exceeds 420kV. When the ac system voltage exceeds 420kV, clause 7.20.3.5 will reflect this change. The relaxation is only required when power transfer is less than 30% of nominal. The way in which the maximum acceptable negative offset is to be relaxed is shown in Figure 19). The equations which describe this are:

Maximum Acceptable Negative Offset (for $10\% \leq P_{o\text{-filtered}} < 30\%$)

$$10\% \leq P_{o\text{-filtered}} < 20\% : \left(\frac{1}{\sqrt[3]{V_{ac} \text{ Diff}}} \times -380 \right)$$

$$20\% \leq P_{o\text{-filtered}} < 30\% : \frac{\left(\frac{1}{\sqrt[3]{V_{ac} \text{ Diff}}} \times -380 \right) - 310}{10} \times (P_{o\text{-filtered}} - 30) - 310$$

Equation 37

Where

$V_{ac} \text{ Diff}$ = ac system voltage relaxation (see Figure 24) - 420kV

7.20.3.5 While the operator asks for convertor deficit offsets which are negative ($CDO_{o/s} < 0$) or surplus offsets which are positive ($CSO_{o/s} > 0$), then under these conditions, RPC can accept these offsets.

IF ($CDO_{o/s} < 0$)
THEN $ACDO_{o/s} = CDO_{o/s}$

IF ($CSO_{o/s} > 0$)
THEN $ACSO_{o/s} = CSO_{o/s}$

7.20.4 In ACVCM, the desired convertor offsets ($CSO_{o/s}, CDO_{o/s}$) shall be calculated based on the target voltage level within the range 380kV to 420kV. These requested convertor offsets ($CSO_{o/s}, CDO_{o/s}$) will then be sent to the RPEM function as described in 7.20.3, which calculates the accepted convertor surplus and

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deficit limits ($ACSO_{e/s}$, $ACDO_{e/s}$).

7.20.4.1 In ACVCM the width of the revised var exchange deadband shall be equal to the default. ACVCM will not be selectable, unless the var exchange deadband is equal to the default i.e. the convertor surplus and deficit limits are equal.

7.20.4.2 Calculation of requested convertor limits ($CSO_{e/s}$, $CDO_{e/s}$) based on the operator target ac system voltage are based on the following equations.

$$\Delta VL_{e/s} = \frac{TVL_{e/s}}{PVL_{e/s}} - 1$$

Equation 38

where:

$\Delta VL_{e/s}$ = Change in Voltage Level to achieve target (pu)

$TVL_{e/s}$ = Target Voltage Level as requested by operator, East/South (line - line kVrms)

$PVL_{e/s}$ = Present Voltage Level at time ACVCM demand is executed, East/South (line - line kVrms)

The necessary change in reactive power to achieve the target voltage is:

$$\Delta Q_{e/s} = SCL_{e/s} \times \Delta VL_{e/s}$$

Equation 39

where:

$\Delta Q_{e/s}$ = Change in reactive power to meet Target Voltage Level, East/South (Mvar)

$SCL_{e/s}$ = Short Circuit Level (East/South)

SCL_e = 1400 MVA (Adjustable between 650 and 10,000 MVA)

SCL_s = 1200 MVA (Adjustable between 1000 and 10,000 MVA)

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The change in reactive power needed to meet the target voltage is then added to the Converter Surplus and Deficit Limits.

For increase in voltage:

$$CDO_{e/s} = PCDO_{e/s} + \Delta Q_{e/s}$$

Equation 40

For decrease in voltage:

$$CSO_{e/s} = PCSO_{e/s} + \Delta Q_{e/s}$$

Equation 41

where:

$PCSO_{e/s}$ = Present Converter Surplus Offsets at the time ACVCM demand is executed, East/South

$PCDO_{e/s}$ = Present Converter Deficit Offsets at the time ACVCM demand is executed, East/South

The Converter Surplus Offsets ($CSO_{e/s}$) are then passed to RPEM as described in Section 7.20.3 this then calculates the accepted converter surplus and deficit limits ($ACSO_{e/s}$, $ACDO_{e/s}$) dependent on the inherent capabilities of the converters. Based on the accepted offsets, the accepted target voltage level and converter offsets will be sent to the MIMIC panel.

7.20.5 Once new converter surplus or deficit limits are calculated these new offsets shall remain fixed until a new target voltage or RPEM mode is selected. This only applies for so long as the operating conditions do not change to reduce the inherent capability of the converters to exert RPEM or ACVCM (see clause 7.20.2 g).

7.20.6 While operating in RPEM or ACVCM mode, the harmonic performance monitor shall determine whether de-energisation of one (1) less filter than given in table 2 down to the number in table 4 is permitted.

IF (No. of energised filters (East/South) = No. in Table 2)
AND

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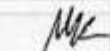
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IF (harmonic performance (East/South) < 0.5 (adjustable between 0.1-0.9)
THEN Min. no. of Filters = Table 4
ELSE Min no. of Filters = Table 2

Recalculate $MACC_{e/s}$ using Table 2 and if necessary update MIMIC

7.20.7 While operating in RPEM or ACVCM, and the harmonic performance monitor detects the limits of clause 7.4.5 being exceeded, RPC shall take appropriate measures to ensure that the harmonic performance is met. This shall be achieved by energising filters up to the maximum given in Table 2 and adjusting the convertor surplus and deficit values in 50Mvar steps (adjustable between 25 and 100). If after energising filters and adjusting convertor surplus and deficit values, the harmonic performance is still exceeded, RPC shall raise the surplus limit on the other side if it has a negative convertor surplus offset.

IF (harmonic performance exceeded (East/South))
AND

IF Min. no. of filters (East/South) = Table 2
Recalculate $MACC_{e/s}$ using Table 2 and if necessary update MIMIC with new accepted offsets
Energise available filters up to number given in Table 2
Measure harmonic performance (East/South)

WHILE ($ACSO_{e/s}$ AND $ACDO_{e/s}$ < 0 AND harmonic performance exceeded (East/South))

THEN

$ACSO_{e/s} = ACSO_{e/s} + 50$ (stop at 0)
 $ACDO_{e/s} = ACDO_{e/s} + 50$ (stop at 0)
Measure harmonic performance (East/South)

WHILE (harmonic performance exceeded (East/South) AND $ACSO_{e/s} < 0$)

THEN

$ACSO_{e/s} = ACSO_{e/s} + 50$ (stop at 0)
Measure harmonic performance (East/South)

7.20.8 If RPEM/ACVCM is applied to one side only, the harmonic performance monitor shall be active on both sides of the link. If the harmonic performance is exceeded on the side without RPEM/ACVCM, then RPC shall first ensure that the maximum number of filters as given in table 2 are energised. Then RPC shall release the convertor surplus limit on the side in RPEM/ACVCM in steps of 50Mvar

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(adjustable between 25 and 100) to improve the harmonic performance.

IF (harmonic performance exceeded while RPEM/ACVCM not selected (East/South) AND RPEM/ACVCM selected (South/East)

AND

IF (number of filters energised (East/South) < table 2)

THEN Energise available filters up to the number given in Table 2 (East/South)

Measure harmonic performance (East/South)

WHILE (harmonic performance exceeded (East/South))

THEN

$ACSO_{c/w} = ACSO_{s/e} + 50$ (stop at 0)

Measure harmonic performance (East/South)

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8 HARDWARE PLATFORM

The IO allocation lists are defined in Related Document [6] and [7].

8.1 Plant Interface

8.1.1 AC Switchyard

Inputs

Outputs

- Breaker=CWD10+Q50 Closed
- Breaker=CWD10+Q50 Opened
- Breaker=CWD10+Q51 Closed
- Breaker=CWD10+Q51 Opened
- Breaker=CWD10+Q52 Closed
- Breaker=CWD10+Q52 Opened
- Breaker=CWD20+Q50 Closed
- Breaker=CWD20+Q50 Opened
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for Reactive Power Control**

Ref. **730/CF0136/T06/
DRM001C.SPC**

Original A **12.5.97**

Situation	Visakhapatnam		Customer	POWERGRID		Approved	BAR
Issue	^a 8.5.98	^c 14.4.99	^d	^e	^f	^g	
Approved	BTB	<i>MR</i>			BTB		

Breaker=CWC36+Q50 Closed
 Breaker=CWC36+Q50 Opened
 Breaker=CWL19+Q50 Closed
 Breaker=CWL19+Q50 Opened
 Breaker=CWL29+Q50 Closed
 Breaker=CWL29+Q50 Opened

C 8.1.2 AC Switchyard (via SCADA System Serial Link to Pole Control)

Inputs

Outputs

Breaker=CWC23+Q50 Available
 Breaker=CWC23+Q50 Unavailable
 Disconnector=CWC23+Q20 Opened
 Disconnector=CWC23+Q20 Closed
 Breaker=CWC24+Q50 Available
 Breaker=CWC24+Q50 Unavailable
 Disconnector=CWC24+Q20 Opened
 Disconnector=CWC24+Q20 Closed
 Breaker=CWC25+Q50 Available
 Breaker=CWC25+Q50 Unavailable
 Disconnector=CWC25+Q20 Opened
 Disconnector=CWC25+Q20 Closed
 Breaker=CWC33+Q50 Available
 Breaker=CWC33+Q50 Unavailable
 Disconnector=CWC33+Q20 Opened
 Disconnector=CWC33+Q20 Closed
 Breaker=CWC34+Q50 Available
 Breaker=CWC34+Q50 Unavailable
 Disconnector=CWC34+Q20 Opened
 Disconnector=CWC34+Q20 Closed
 Breaker=CWC35+Q50 Available
 Breaker=CWC35+Q50 Unavailable
 Disconnector=CWC35+Q20 Opened
 Disconnector=CWC35+Q20 Closed
 Breaker=CWC36+Q50 Available
 Breaker=CWC36+Q50 Unavailable
 Disconnector=CWC35+Q20 Opened
 Disconnector=CWC35+Q20 Closed
 Breaker=CWL19+Q50 Available

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Situation	Visakhapatnam	Customer	POWERGRID	Approved	BAR
Issue	^a 8.5.98	^c 14.4.99	^d	^e	^f
Approved	BTB	<i>ML</i>		<i>ML</i>	BTB

Breaker=CWL19+Q50 Unavailable
 Disconnector=CWL19+Q27 Opened
 Disconnector=CWL19+Q27 Closed
 Breaker=CWL29+Q50 Available
 Breaker=CWL29+Q50 Unavailable
 Disconnector=CWL29+Q27 Opened
 Disconnector=CWL29+Q27 Closed
 Disconnector=CWL21+Q26 Opened
 Disconnector=CWL21+Q26 Closed
 Disconnector=CWL12+Q26 Opened
 Disconnector=CWL12+Q26 Closed
 Disconnectors=CWD10+Q20 and +Q21 Opened
 Disconnectors=CWD10+Q20 and +Q21 Closed
 Disconnectors=CWD10+Q22 and +Q23 Opened
 Disconnectors=CWD10+Q22 and +Q23 Closed
 Disconnectors=CWD10+Q24 and +Q25 Opened
 Disconnectors=CWD10+Q24 and +Q25 Closed
 Disconnectors=CWD20+Q20 and +Q21 Opened
 Disconnectors=CWD20+Q20 and +Q21 Closed
 Disconnectors=CWD20+Q22 and +Q23 Opened
 Disconnectors=CWD20+Q22 and +Q23 Closed
 Disconnectors=CWD20+Q24 and +Q25 Opened
 Disconnectors=CWD20+Q24 and +Q25 Closed
 Disconnectors=CWD30+Q20 and +Q21 Opened
 Disconnectors=CWD30+Q20 and +Q21 Closed
 Disconnectors=CWD30+Q22 and +Q23 Opened
 Disconnectors=CWD30+Q22 and +Q23 Closed
 Disconnectors=CWD30+Q24 and +Q25 Opened
 Disconnectors=CWD30+Q24 and +Q25 Closed
 Disconnectors=CWE02+Q20 Opened
 Disconnectors=CWE02+Q20 Closed
 Disconnectors=CWE02+Q21 Opened
 Disconnectors=CWE02+Q21 Closed

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				Original A	12.5.97
Situation		Visakhapatnam		Customer	POWERGRID
Issue		^b 8.5.98	^c 14.4.99	Approved	BAR
Approved		BTB	<i>My</i>		

8.1.3 AC Plant Measurements

Inputs

- Jeypore Line 1 CT Red Phase
(for Var measurement)
- Jeypore Line 1 CT Yellow Phase
(for Var measurement)
- Jeypore Line 1 CT Blue Phase
(for Var measurement)
- Jeypore Line 1 VT Red Phase
(for Var measurement)
- Jeypore Line 1 VT Yellow Phase
(for Var measurement)
- Jeypore Line 1 VT Blue Phase
(for Var measurement)
- Jeypore Line 2 CT Red Phase
(for Var measurement)
- Jeypore Line 2 CT Yellow Phase
(for Var measurement)
- Jeypore Line 2 CT Blue Phase
(for Var measurement)
- Jeypore Line 2 VT Red Phase
(for Var measurement)
- Jeypore Line 2 VT Yellow Phase
(for Var measurement)
- Jeypore Line 2 VT Blue Phase
(for Var measurement)
- Busbar 1 South CT Red Phase
(for Var measurement)
- Busbar 1 South CT Yellow Phase
(for Var measurement)
- Busbar 1 South CT Blue Phase
(for Var measurement)
- Busbar 1 South VT Red Phase
(for Var measurement)
- Busbar 1 South VT Yellow Phase
(for Var measurement)
- Busbar 1 South VT Blue Phase
(for Var measurement)

Outputs

none

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Approved	BTB	<i>Mc</i>				

Original A 12.5.97

Approved BAR

Busbar 2 South CT Red Phase
(for Var measurement)
Busbar 2 South CT Yellow Phase
(for Var measurement)
Busbar 2 South CT Blue Phase
(for Var measurement)
Busbar 2 South VT Red Phase
(for Var measurement)
Busbar 2 South VT Yellow Phase
(for Var measurement)
Busbar 2 South VT Blue Phase
(for Var measurement)

C 8.2 Mimic Interface (via SCADA System Serial link to Pole Control)

Inputs

Breaker=CWC23+Q50 Close
(Mimic Switch)
Breaker=CWC23+Q50 Open
(Mimic Switch)
Breaker=CWC24+Q50 Close
(Mimic Switch)
Breaker=CWC24+Q50 Open
(Mimic Switch)
Breaker=CWC25+Q50 Close
(Mimic Switch)
Breaker=CWC25+Q50 Open
(Mimic Switch)
Breaker=CWC33+Q50 Close
(Mimic Switch)
Breaker=CWC33+Q50 Open
(Mimic Switch)
Breaker=CWC34+Q50 Close
(Mimic Switch)
Breaker=CWC34+Q50 Open
(Mimic Switch)
Breaker=CWC35+Q50 Close
(Mimic Switch)

Outputs

Breaker=CWC23+Q50 Close
(Operator Prompt Lamp)
Breaker=CWC23+Q50 Open
(Operator Prompt Lamp)
Breaker=CWC24+Q50 Close
(Operator Prompt Lamp)
Breaker=CWC24+Q50 Open
(Operator Prompt Lamp)
Breaker=CWC25+Q50 Close
(Operator Prompt Lamp)
Breaker=CWC25+Q50 Open
(Operator Prompt Lamp)
Breaker=CWC33+Q50 Close
(Operator Prompt Lamp)
Breaker=CWC33+Q50 Open
(Operator Prompt Lamp)
Breaker=CWC34+Q50 Close
(Operator Prompt Lamp)
Breaker=CWC34+Q50 Open
(Operator Prompt Lamp)
Breaker=CWC35+Q50 Close
(Operator Prompt Lamp)

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Title: Functional Specification
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Original A 12.5.97

Situation	Visakhapatnam		Customer	POWERGRID		Approved	BAR
Issue	^b 8.5.98	^c 14.4.99	^d	^e	^f	^g	
Approved	BTB	<i>MK</i>					

Breaker = CWC35 + Q50 Open
(Mimic Switch)
Breaker = CWC36 + Q50 Close
(Mimic Switch)
Breaker = CWC36 + Q50 Open
(Mimic Switch)
Breaker = CWL19 + Q50 Close
(Mimic Switch)
Breaker = CWL19 + Q50 Open
(Mimic Switch)
Breaker = CWL29 + Q50 Close
(Mimic Switch)
Breaker = CWL29 + Q50 Open
(Mimic Switch)

Breaker = CWC35 + Q50 Open
(Operator Prompt Lamp)
Breaker = CWC36 + Q50 Close
(Operator Prompt Lamp)
Breaker = CWC36 + Q50 Open
(Operator Prompt Lamp)
Breaker = CWL19 + Q50 Close
(Operator Prompt Lamp)
Breaker = CWL19 + Q50 Open
(Operator Prompt Lamp)
Breaker = CWL29 + Q50 Close
(Operator Prompt Lamp)
Breaker = CWL29 + Q50 Open
(Operator Prompt Lamp)

8.3 Control Interface

8.3.1 Valve Control

Inputs

Thermal Analogue East T_j
Thermal Analogue East T_j'
Thermal Analogue South T_j
Thermal Analogue South T_j'

Outputs

None

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Approved	BTB		<i>MK</i>

8.3.2 Pole Control/Protection - Contacts

Inputs

Com Fail East
Com Fail South
Excessive VAR Demand Warning South
Excessive VAR Demand Warning East
Trip Pole
Transputer Link Signals

Outputs

None

8.3.3 Pole Control/Protection - Analogue

Inputs

Vlw(1-n) 3 phase South (Magnitude)
Vlw(1-n) 3 phase East (Magnitude)
Vlw South B-phase
(For Harmonic Analysis)
Vlw South R-Phase
(For Harmonic Analysis)
Vlw South Y-Phase
(For Harmonic Analysis)
Vlw East B-phase
(For Harmonic Analysis)
Vlw East R-Phase
(For Harmonic Analysis)
Vlw East Y-Phase
(For Harmonic Analysis)

Outputs

None

8.3.4 Protection - Contacts

Inputs

None

Outputs

Breaker=CWC23+Q50 Close
Breaker=CWC24+Q50 Close
Breaker=CWC25+Q50 Close
Breaker=CWC33+Q50 Close

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**GEC ALSTHOM T&D
POWER ELECTRONIC SYSTEMS LIMITED**

Specification No. **CF0136/0012/FUNC**

Sheet **67** of 102

Title: **Functional Specification
for Reactive Power Control**

Ref. **730/CF0136/T06/
DRM001C.SPC**

Original A **12.5.97**

Situation	Visakhapatnam		Customer	POWERGRID	Approved	BAR
Issue	^a 8.5.98	^c 14.4.99	^d	^e	^f	^g
Approved	BTB	<i>ML</i>				

Breaker = CWC34 + Q50 Close
Breaker = CWC35 + Q50 Close
Breaker = CWC36 + Q50 Close
Breaker = CWL19 + Q50 Close
Breaker = CWL29 + Q50 Close

8.3.5 Clause not used

8.3.6 Satellite Clock

Inputs

Outputs

Time Sync Pulse (IPP5S)

None

8.4 Alarms

8.4.1 SER (SCADA Bay Interface Outstation - hard-wired)

These outputs are only active when the SCADA serial link is inoperable.

Inputs

Outputs

None

RPC PCB Interlock Fail
RPC Processor WatchDog
RPC Supply Warning Alarm
RPC Supply Minor Alarm

8.4.2 SER (via SCADA Serial Link - software alarms)

Inputs

Outputs

None

Breaker = CWC23 + Q50 Not Responding
Breaker = CWC24 + Q50 Not Responding
Breaker = CWC25 + Q50 Not Responding
Breaker = CWC33 + Q50 Not Responding
Breaker = CWC34 + Q50 Not Responding
Breaker = CWC35 + Q50 Not Responding
Breaker = CWC36 + Q50 Not Responding
Breaker = CWL19 + Q50 Not Responding
Breaker = CWL29 + Q50 Not Responding

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Title: Functional Specification
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				Original A	12.5.97	
Situation	Visakhapatnam		Customer	POWERGRID	Approved	BAR
Issue	^a 8.5.98	^c 14.4.99	^d	^e	^f	^g
Approved	BTB	<i>MK</i>				

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- RPC Warning Alarm (1)
- RPC Warning Alarm (2)
- RPC Warning Alarm (3)
- RPC Warning Alarm (4)
- RPC Warning Alarm (5)
- RPC Warning Alarm (6)
- RPC Warning Alarm (7)
- RPC Warning Alarm (8)
- RPC Warning Alarm (9)
- RPC Warning Alarm (10)
- RPC Warning Alarm (11)
- RPC Warning Alarm (12)
- RPC Warning Alarm (13)
- RPC Warning Alarm (14)
- RPC Warning Alarm (15)
- RPC Warning Alarm (16)
- RPC Minor Alarm (1)
- RPC Minor Alarm (2)
- RPC Minor Alarm (3)
- RPC Minor Alarm (4)
- RPC Minor Alarm (5)
- RPC Minor Alarm (6)
- RPC Minor Alarm (7)
- RPC Minor Alarm (8)
- RPC Minor Alarm (9)
- RPC Minor Alarm (10)
- RPC Minor Alarm (11)
- RPC Minor Alarm (12)
- RPC Minor Alarm (13)
- RPC Minor Alarm (14)
- RPC Minor Alarm (15)
- RPC Minor Alarm (16)

8.4.3 Backup Alarm System

Inputs

Outputs

None

Cubicle Warning Alarm
Cubicle Minor Alarm

Title: Functional Specification for Reactive Power Control				Ref. 730/CF0136/T06/ DRM001C.SPC		
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Situation	Visakhapatnam		Customer	POWERGRID	Approved	BAR
Issue	^b 8.5.98	^c 14.4.99	^d	^e	^f	^g
Approved	BTB	<i>AMK</i>			BTB	

8.5 Not Used

8.6 Filter Protection

Inputs

Trip Imminent East (Filter Protection)
Trip Imminent South (Filter Protection)

Breaker=CWC23+Q50 Lockout - [from Filter Protection]
Breaker=CWC24+Q50 Lockout - [from Filter Protection]
Breaker=CWC25+Q50 Lockout - [from Filter Protection]
Breaker=CWL19+Q50 Lockout - [from Reactor Protection]
Breaker=CWL29+Q50 Lockout - [from Reactor Protection]
Breaker=CWC33+Q50 Lockout - [from Filter Protection]
Breaker=CWC34+Q50 Lockout - [from Filter Protection]
Breaker=CWC35+Q50 Lockout - [from Filter Protection]
Breaker=CWC36+Q50 Lockout - [from Filter Protection]

Outputs

Inhibit Unbalance Prot'n Filter CWC25
Inhibit Unbalance Prot'n Filter (1) CWC24
Inhibit Unbalance Prot'n Filter (2) CWC24
Inhibit Unbalance Prot'n Filter (1) CWC23
Inhibit Unbalance Prot'n Filter (2) CWC23
Inhibit Unbalance Prot'n Filter CWC36
Inhibit Unbalance Prot'n Filter CWC35
Inhibit Unbalance Prot'n Filter (1) CWC34
Inhibit Unbalance Prot'n Filter (2) CWC34
Inhibit Unbalance Prot'n Filter (1) CWC33
Inhibit Unbalance Prot'n Filter (2) CWC33

Breaker=CWC23+Q50 Open1
Breaker=CWC23+Q50 Open2
Breaker=CWC24+Q50 Open1
Breaker=CWC24+Q50 Open2
Breaker=CWC25+Q50 Open1

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**GEC ALSTHOM T&D
POWER ELECTRONIC SYSTEMS LIMITED**

Specification No. CF0136/0012/FUNC

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Title: Functional Specification
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Original A 12.5.97

Situation	Visakhapatnam		Customer	POWERGRID		Approved	BAR
Issue	^a 8.5.98	^c 14.4.99	^d	^e	^f	^g	
Approved	BTB	<i>MK</i>					

- Breaker = CWC25 + Q50 Open2
- Breaker = CWC33 + Q50 Open1
- Breaker = CWC33 + Q50 Open2
- Breaker = CWC34 + Q50 Open1
- Breaker = CWC34 + Q50 Open2
- Breaker = CWC35 + Q50 Open1
- Breaker = CWC35 + Q50 Open2
- Breaker = CWC36 + Q50 Open1
- Breaker = CWC36 + Q50 Open2
- Breaker = CWL19 + Q50 Open1
- Breaker = CWL19 + Q50 Open2
- Breaker = CWL29 + Q50 Open1
- Breaker = CWL29 + Q50 Open2

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Approved	BTB	<i>Mk</i>					

9 TESTING

The system shall be tested in conjunction with a suitable representation of the converter control equipment and a model of the ac system. A full test specification can be found in CF0136/0012/FTS

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Situation Visakhapatnam

Customer POWERGRID

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14.4.99

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APPENDIX 1 QUALITY ASSURANCE, INSPECTION AND IDENTIFICATION

Project Quality

The equipment and/or services specified herein are subject to the requirements of the Project Specification, Project Quality Plans and GEC ALSTHOM T&D Power Electronic Systems Limited Procedures. Any deviation from these requirements shall be subject to approval by the Project Quality Manager (Visakhapatnam), via the Company's purchasing authority when appropriate.

Nonconforming Material and Equipment

Nonconforming material shall be subject to concession by GEC ALSTHOM T&D Power Electronic Systems Limited prior to any work being performed.

Concessions shall be submitted for minor deviations and repairs for approval by GEC ALSTHOM T&D Power Electronic Systems Limited. No affected material or equipment shall be released until concession is granted.

Approved Suppliers/Subcontractors

All suppliers/subcontractors of goods and services shall be subject to requirements for assessment and approval as detailed in GEC ALSTHOM T&D Power Electronic Systems Limited procedures. Copies of Supplier Assessment Reports may be made available to the Customer. When specified in the purchase order the supplier/subcontractor shall submit a Quality Plan showing all manufacturing operation including inspection and test activities for approval of GEC ALSTHOM T&D Power Electronic Systems Limited and its Client.

Supplier/Subcontract Surveillance

During the course of the contract GEC ALSTHOM T&D Power Electronic Systems Limited and its Client may monitor the supplier's or subcontractor's activities against the requirements of the Quality Plan. Monitoring may be by surveillance at the work location or by audit of the systems and records. The supplier/subcontractor shall ensure Corrective Action is carried out on any deficiencies observed during surveillance.

**GEC ALSTHOM T&D
POWER ELECTRONIC SYSTEMS LIMITED**

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Approved	BTB	<i>MM</i>				BTB	

GEC ALSTHOM T&D Power Electronic Systems Limited and its Client shall be afforded the right to witness inspections and tests at the supplier's/subcontractor's premises in accordance with the Quality Plan.

Identification and Traceability

All equipments, subassemblies and components shall be traceable by individual serial or batch number through all stages of manufacture.

Type Tests

Type Test reports or reports of Type Tests on similar equipment are required for approval by GEC ALSTHOM T&D Power Electronic Systems Limited and its Client appropriate for all major equipments as defined by Equipment Specifications. Evidence of approval of reports shall be available in advance of Customer Witness of Test and Inspection.

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Situation Visakhapatnam

Customer POWERGRID

Approved BAR

Issue ^a 8.5.98

^c 14.4.99

Approved BTB

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APPENDIX 2

WEIGHTING FACTOR F_n FOR TIF CALCULATION

Harmonic Order (n)	Weighting Factor (F_n)	Harmonic Order (n)	Weighting Factor (F_n)
1	0.4	26	6170
2	6.8	27	6300
3	20	28	6460
4	55	29	6660
5	125	30	6680
6	225	31	6770
7	371	32	6910
8	567	33	7020
9	800	34	7150
10	1070	35	7360
11	1400	36	7570
12	1790	37	7780
13	2180	38	7990
14	2590	39	8200
15	3060	40	8410
16	3520	41	8620
17	3920	42	8830
18	4350	43	9040
19	4630	44	9250
20	4960	45	9460
21	5250	46	9670
22	5480	47	9880
23	5670	48	10090
24	5860	49	10300
25	6020	50	10430

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Approved	BTB	<i>Me</i>			BTB		

TABLE 1a : Reactive Power Export Limits - Southern Region

(From the Contract Document)

Direct Power [% of 500MW]	Southern Rectifier - AC System Absorption Limit [Mvar]	Southern Rectifier - AC System Delivery Limit [Mvar]	Southern Inverter - AC System Absorption Limit [Mvar]	Southern Inverter - AC System Delivery Limit [Mvar]
0	32.5	-88.0	32.5	-88.0
10	30.0	-92.2	35.2	-81.8
20	27.6	-96.5	37.9	-75.5
30	26.2	-99.2	43.7	-69.6
40	24.9	-101.7	50.0	-63.6
50	23.6	-104.2	56.2	-57.7
60	24.8	-104.5	62.8	-48.8
70	26.3	-104.5	69.4	-39.4
80	27.8	-104.5	75.9	-30.0
90	29.4	-104.5	82.5	-20.7
100	30.9	-104.5	89.1	-11.4
110	34.3	-102.3	97.0	0.0
120	34.3*	-102.3*	97.0*	0.0*
130	34.3*	-102.3*	97.0*	0.0*
140	34.3*	-102.3*	97.0*	0.0*

* Values proposed by GEC ALSTHOM

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Customer POWERGRID

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Issue ^B 8.5.98

^C 14.4.99

Approved BTB

MC

TABLE 1b : Reactive Power Export Limits - Eastern Region

(From the Contract Document)

Direct Power [% of 500MW]	Eastern Rectifier - AC System Absorption Limit [Mvar]	Eastern Rectifier - AC System Delivery Limit [Mvar]	Eastern Inverter - AC System Absorption Limit [Mvar]	Eastern Inverter - AC System Delivery Limit [Mvar]
0	-137.3	-267.7	-137.3	-267.7
10	-136.0	-264.0	-139.5	-267.7
20	-134.7	-260.5	-141.7	-267.7
30	-127.3	-253.7	-141.2	-263.5
40	-118.9	-246.5	-140.0	-258.8
50	-110.6	-239.4	-139.3	-254.0
60	-96.8	-220.8	-132.8	-240.9
70	-82.2	-200.7	-125.6	-226.6
80	-67.6	-180.6	-118.3	-212.4
90	-53.0	-160.5	-111.0	-198.1
100	-38.5	-140.4	-103.8	-183.8
110	-20.0	-115.0	-93.8	-165.8
120	-20.0*	-115.0*	-93.8*	-165.8*
130	-20.0*	-115.0*	-93.8*	-165.8*
140	-20.0*	-115.0*	-93.8*	-165.8*

* Values proposed by GEC ALSTHOM

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Situation	Visakhapatnam	Customer	POWERGRID
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Approved		BAR	

Table 2 : Harmonic Performance-Determined Filter Switch Points

Power	< 550MW
Number of Combined Filters	1
Number of Double Damped filters	1

**Table 3a : Actions to be Taken if a Filter Breaker Fails to Respond
(If Demand is for Energisation)**

IF demand is for	AND the reason for the demand is for	AND	THEN
Energisation	Harmonic reasons	a D-type filter is available	energise a D-filter as per clause 7.5.1 ^a
		a D-type filter is not available	energise a combined filter as per clause 7.5.1 ^a
	Var reasons	a D-type filter is available	energise a D-filter as per clause 7.5.1 ^a
		a D-type filter is unavailable but a combined filter is available	energise a combined filter as per clause 7.5.1 ^a
		a D-type or combined filter is NOT available	restore the direct voltage immediately to the pre-switching value

a) After a successful energisation event the action to be taken shall be as per clause 7.5.3.

b) See Figure 11 for the variations in direct voltage when attempting to switch an alternative filter.

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Table 3b : Actions to be Taken if a Filter Breaker Fails to Respond
(If Demand is for De-energisation)

IF demand is for	AND	AND	THEN
De-energisation	the second combined filter is energised		de-energise a combined filter as per clause 7.5.1 ^a
	a D-type filter is energised	number of filters energised exceeds the number pre-determined from worst case harmonic calculation results (see table 2)	de-energise a D-type filter as per clause 7.5.1 ^a
		number of filters energised equals the pre-determined number (see table 2) AND the measured harmonic performance at the 400 kV busbar is favourable (see clause 7.4.3)	de-energise a D-type filter as per clause 7.5.1 ^a
		number of filters energised equals the pre-determined number (see table 2) AND the measured harmonic performance at the 400 kV busbar is unfavourable (see clause 7.4.3)	progressively restore the direct voltage to the pre-switching value within 2 seconds (adjustable between 1 second and 5 seconds)

a) After a successful de-energisation event the action to be taken shall be as per clause 7.6.2.

b) See Figure 11 for the variations in direct voltage when attempting to switch an alternative filter.

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Table 4 : Filter Switching Strategy for RPEM/ACVCM

Power	< 550MW
Number of Combined Filters	1
Number of Double Damped filters	0

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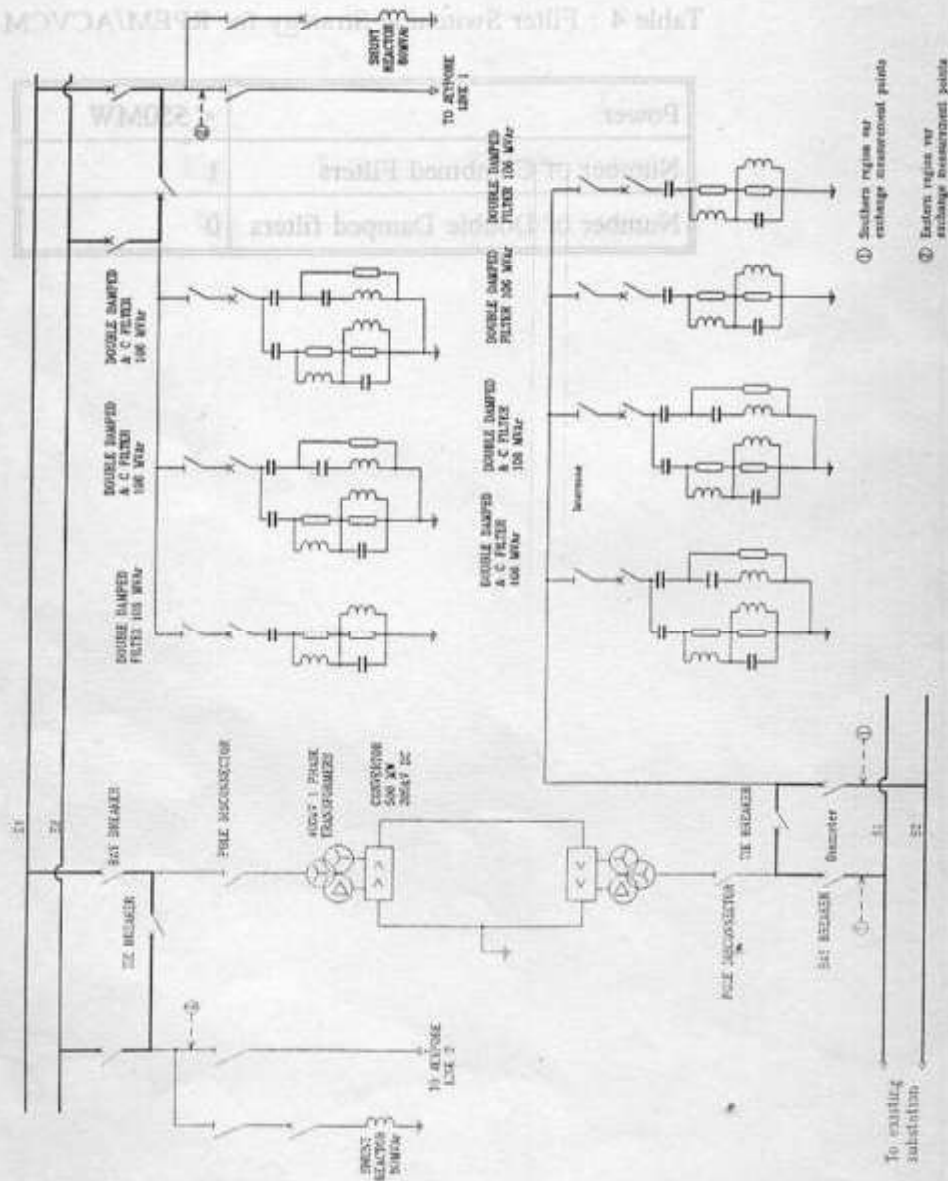
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- ① Southern region HV exchange measurement points
- ② Eastern region HV exchange measurement points

Figure 1: Simplified HVDC System Diagram

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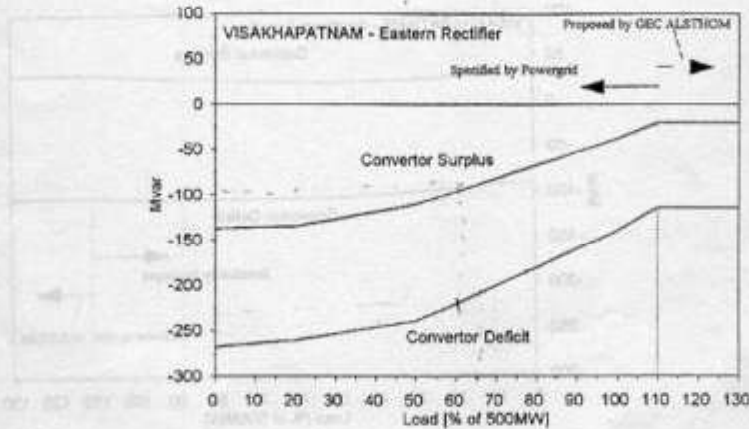


Figure 2a: Reactive Power Exchange Limits, Visakhapatnam Eastern Rectifier

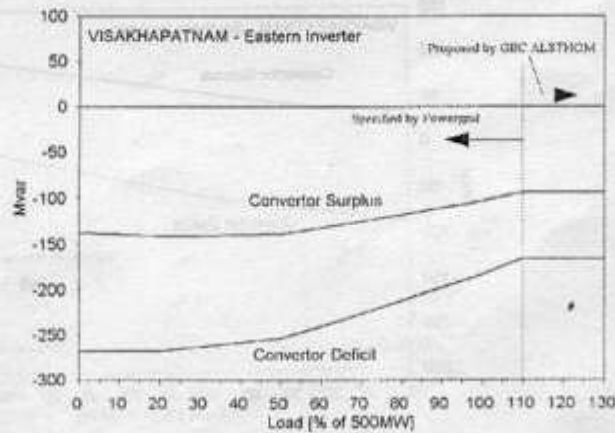


Figure 2b: Reactive Power Exchange Limits, Visakhapatnam Eastern Inverter

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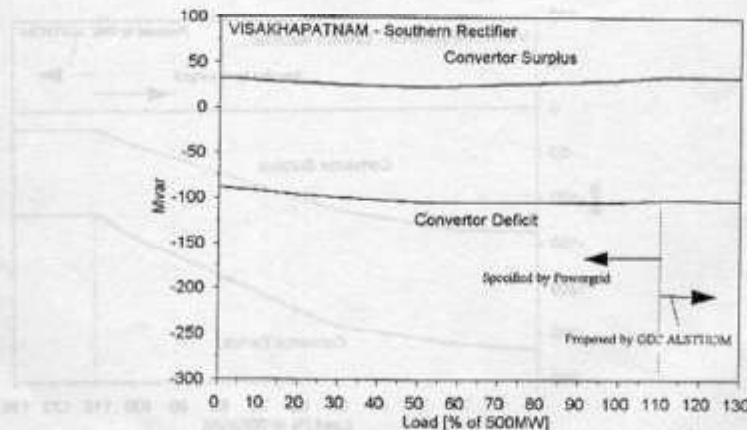


Figure 3a: Reactive Power Exchange Limits,
Visakhapatnam Southern Rectifier

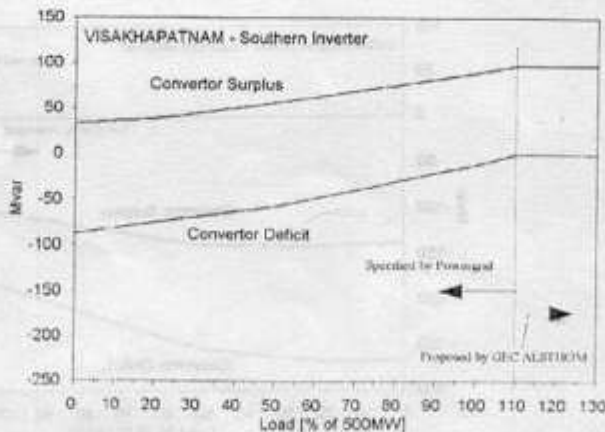


Figure 3b: Reactive Power Exchange Limits,
Visakhapatnam Southern Inverter

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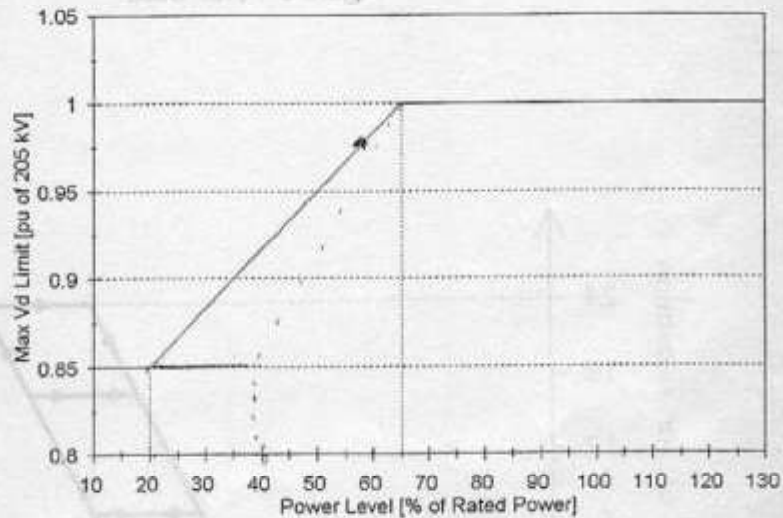


Figure 4 : Maximum Direct Voltage Target

For increase in power transfer (ramp/step changes) the slew rate on Vd is given as:

$$\frac{0.15}{A} \text{ pu/sec}$$

where A = 78 (adjustable between 60 and 96)

For decrease in power transfer (ramp/step changes) the slew rate on Vd is given as:

$$\frac{0.15}{B} \text{ pu/sec}$$

where B = 2 (adjustable between 0.5 and 5)

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Figure 5 : Not Used

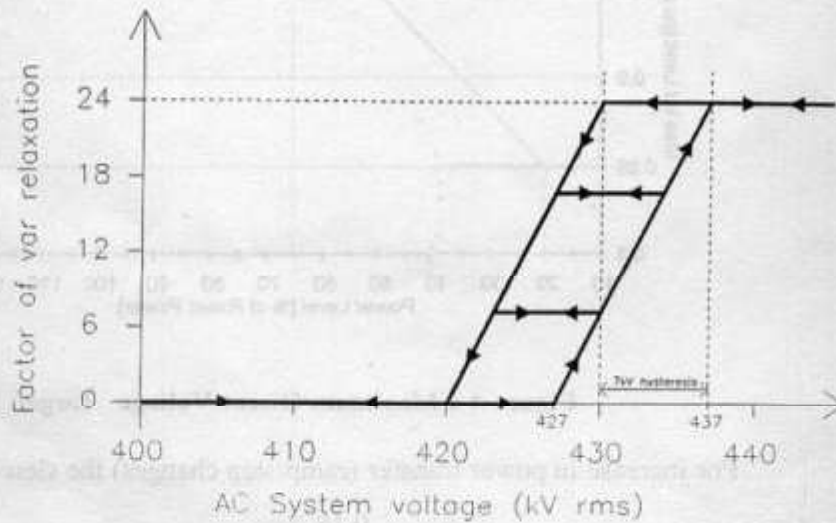


Figure 6 : Reactive Power Relaxation Characteristic

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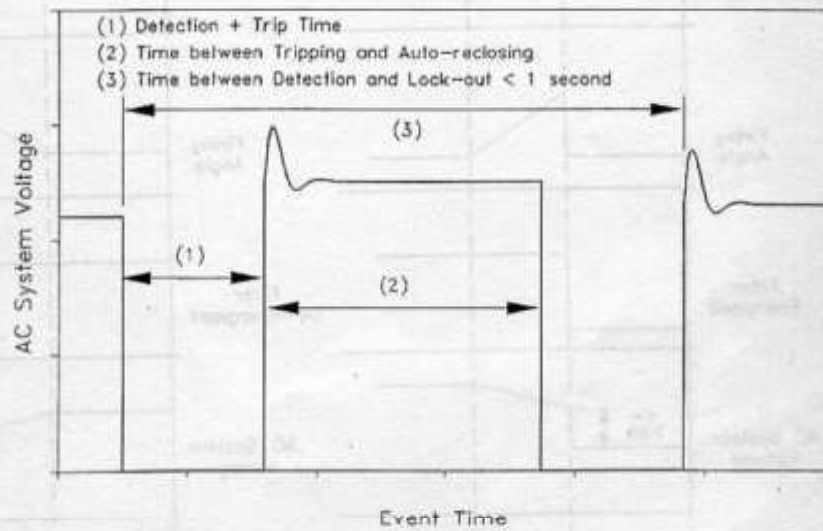


Figure 7 : Distance Protection Lock-Out Time

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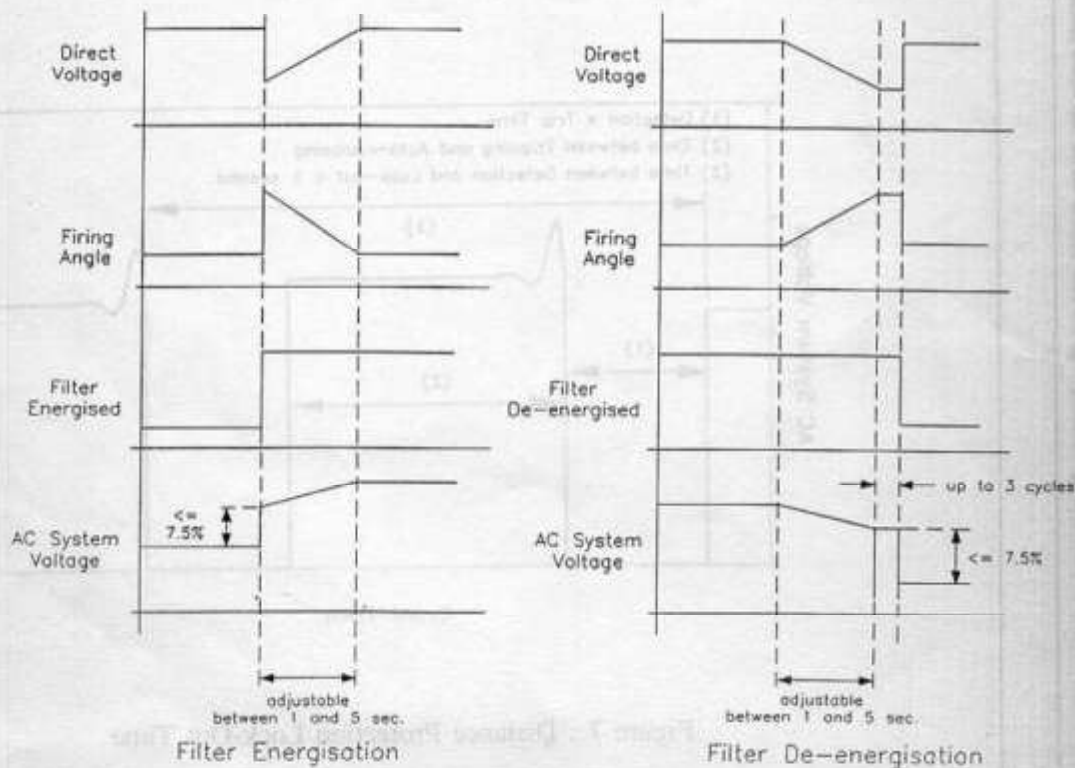


Figure 8 : Pre/Post-Conditioning Process for Filter Switching

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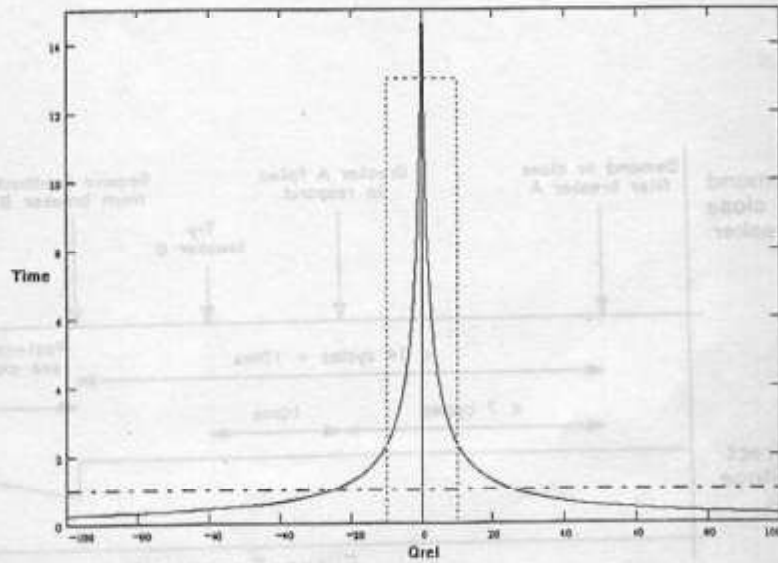
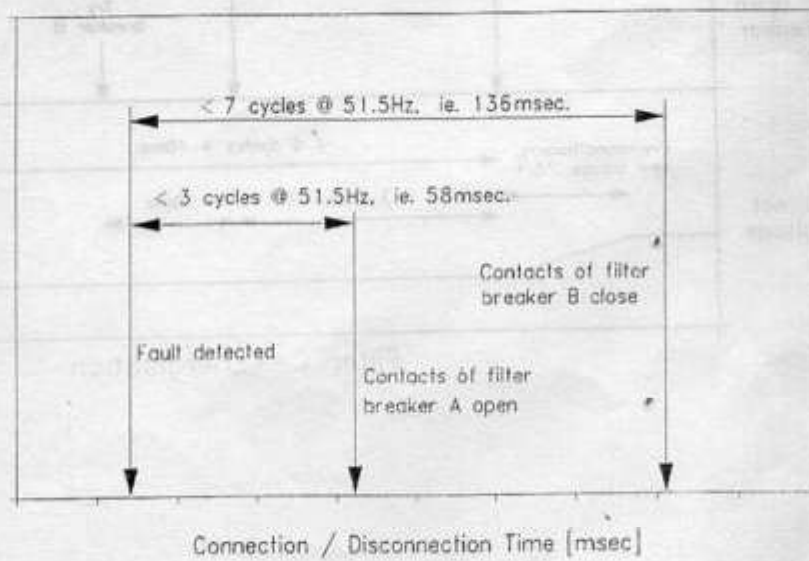


Figure 9 : IDMT Control Characteristic



Connection / Disconnection Time [msec]

Figure 10 : Maximum Permissible Filter Breaker Closing/Opening Time

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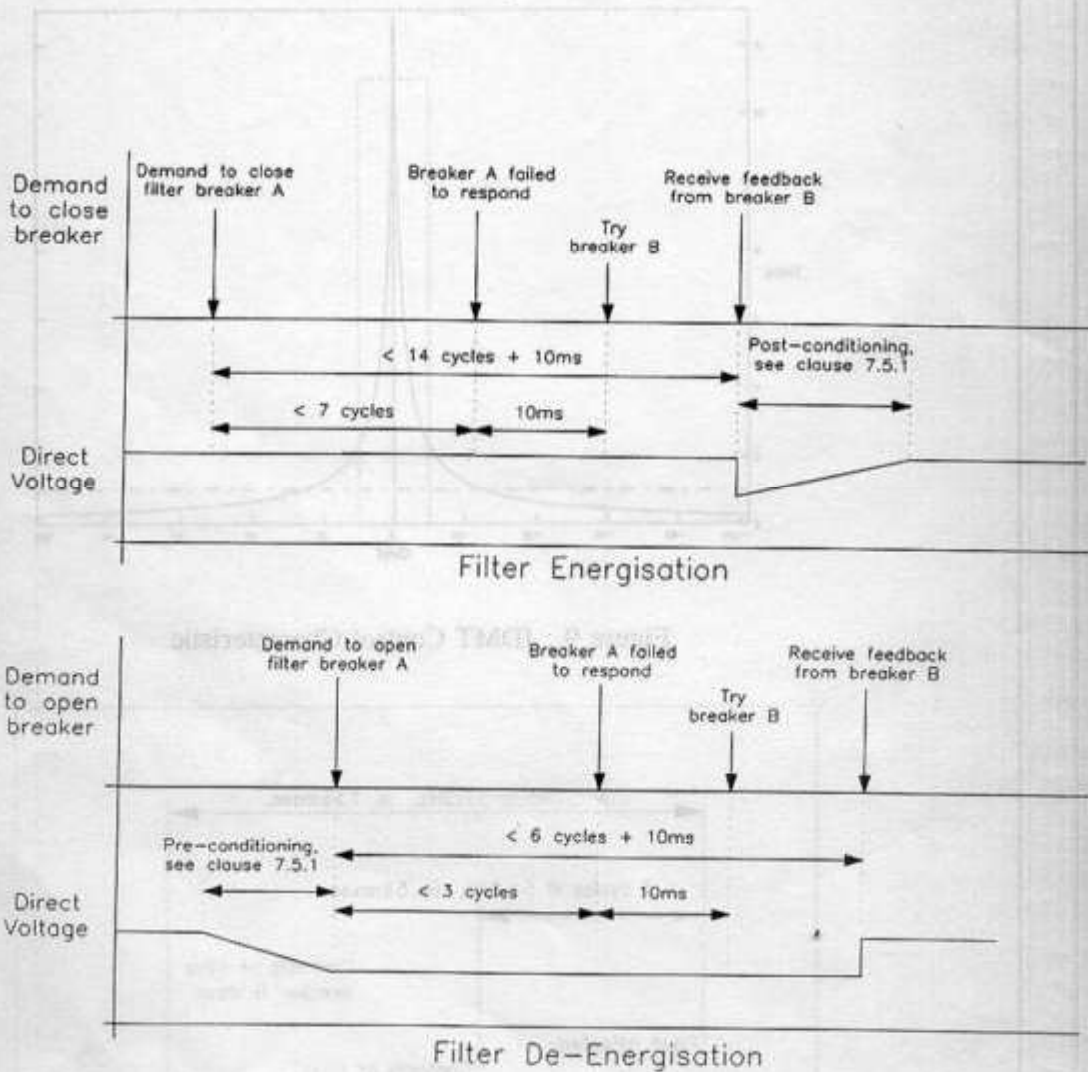


Figure 11 : Actions to be Taken when Breaker Failed to Respond

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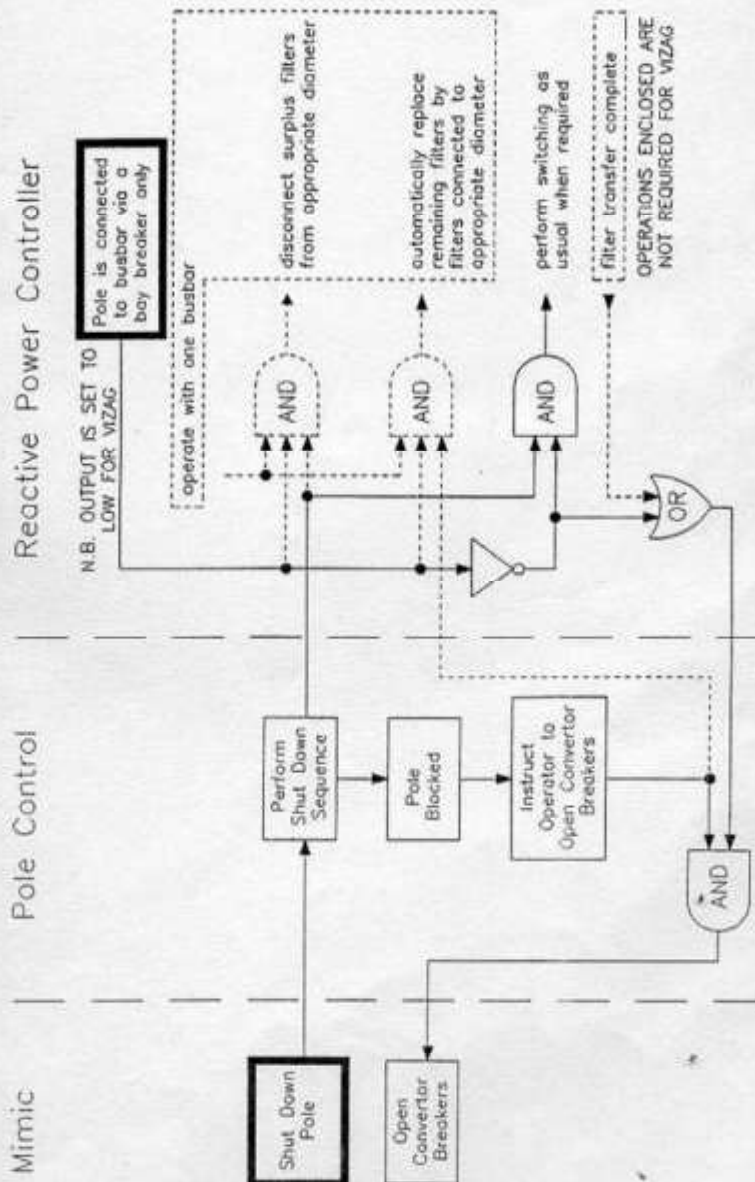


Figure 12 : Element Switching During Special Operating Conditions

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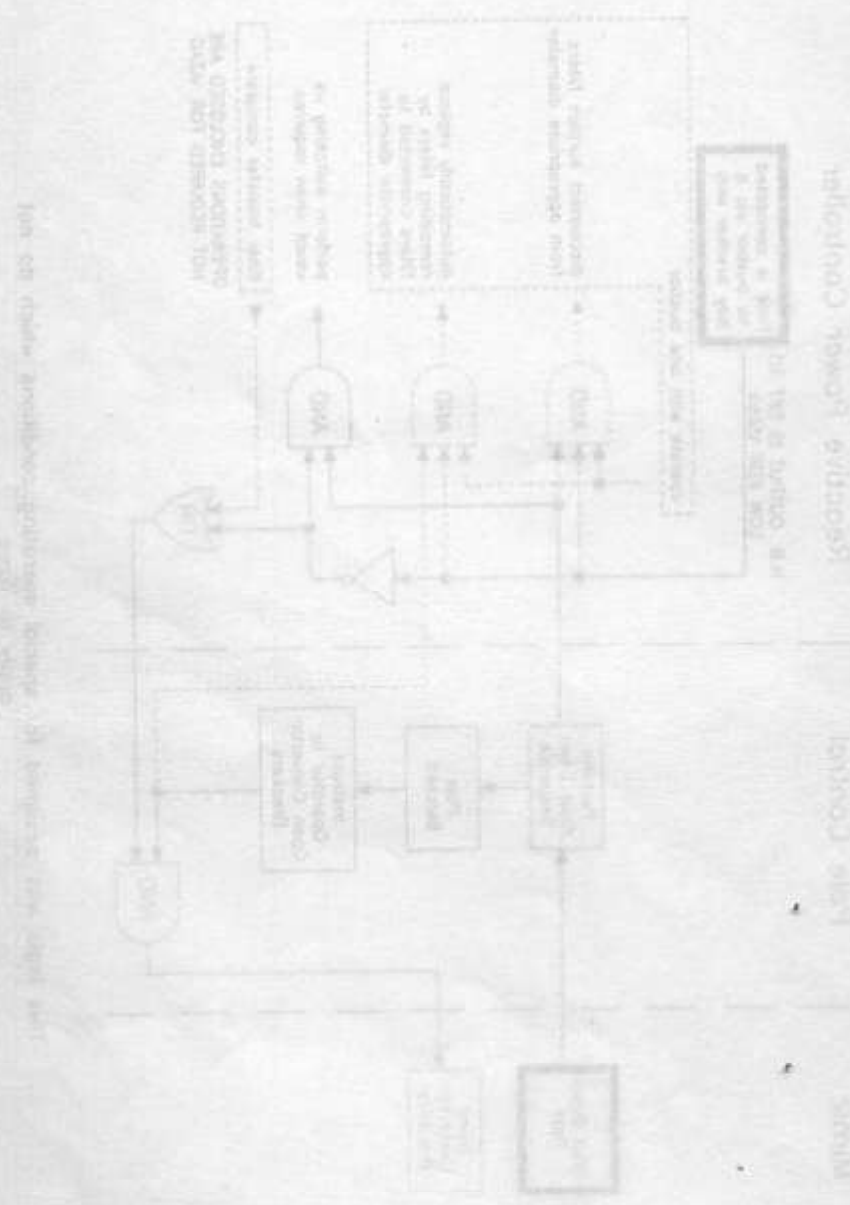
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Figure 13 : Not Used



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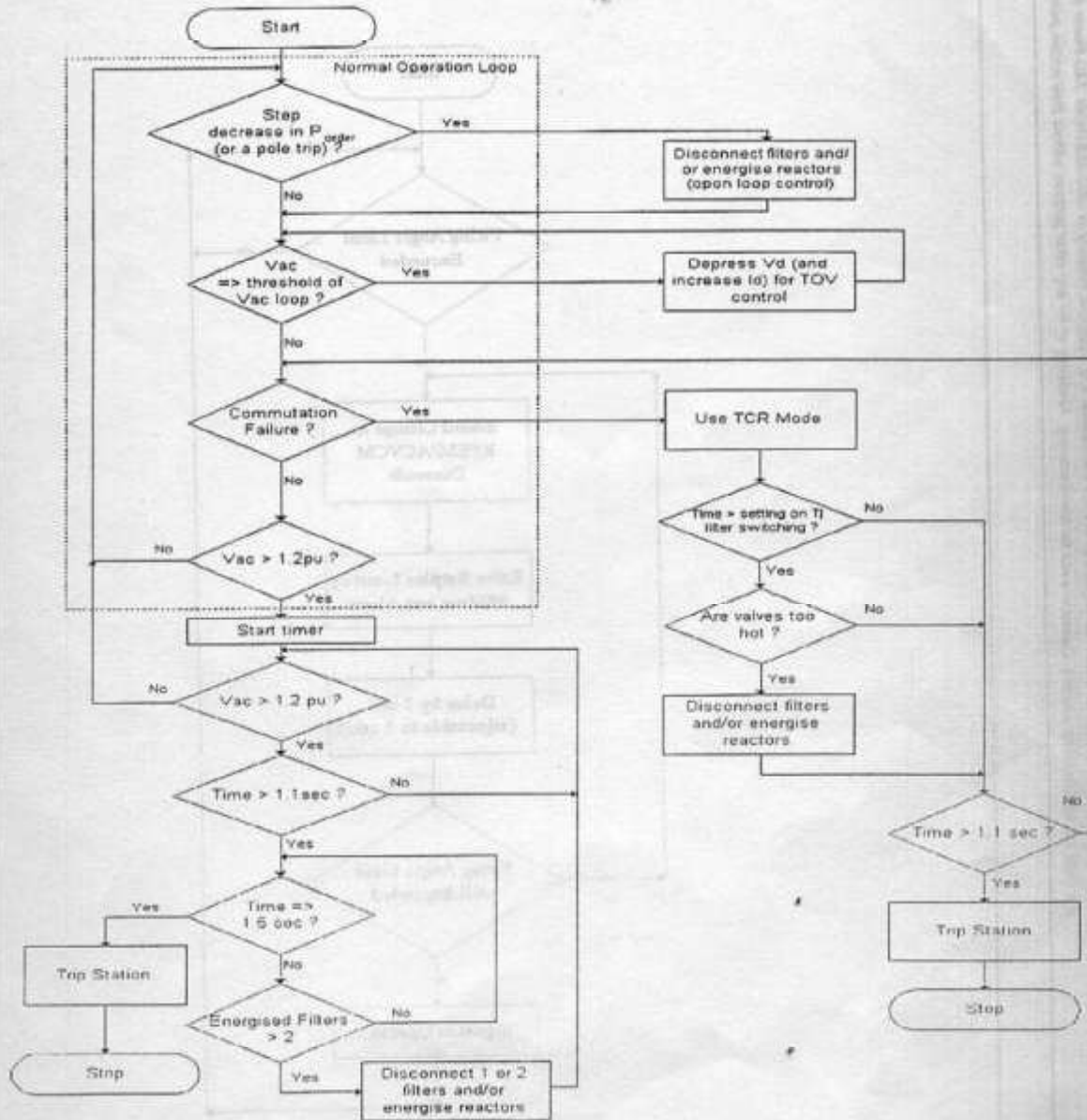


Figure 14 : Overall TOV Control Strategy (Conceptual)

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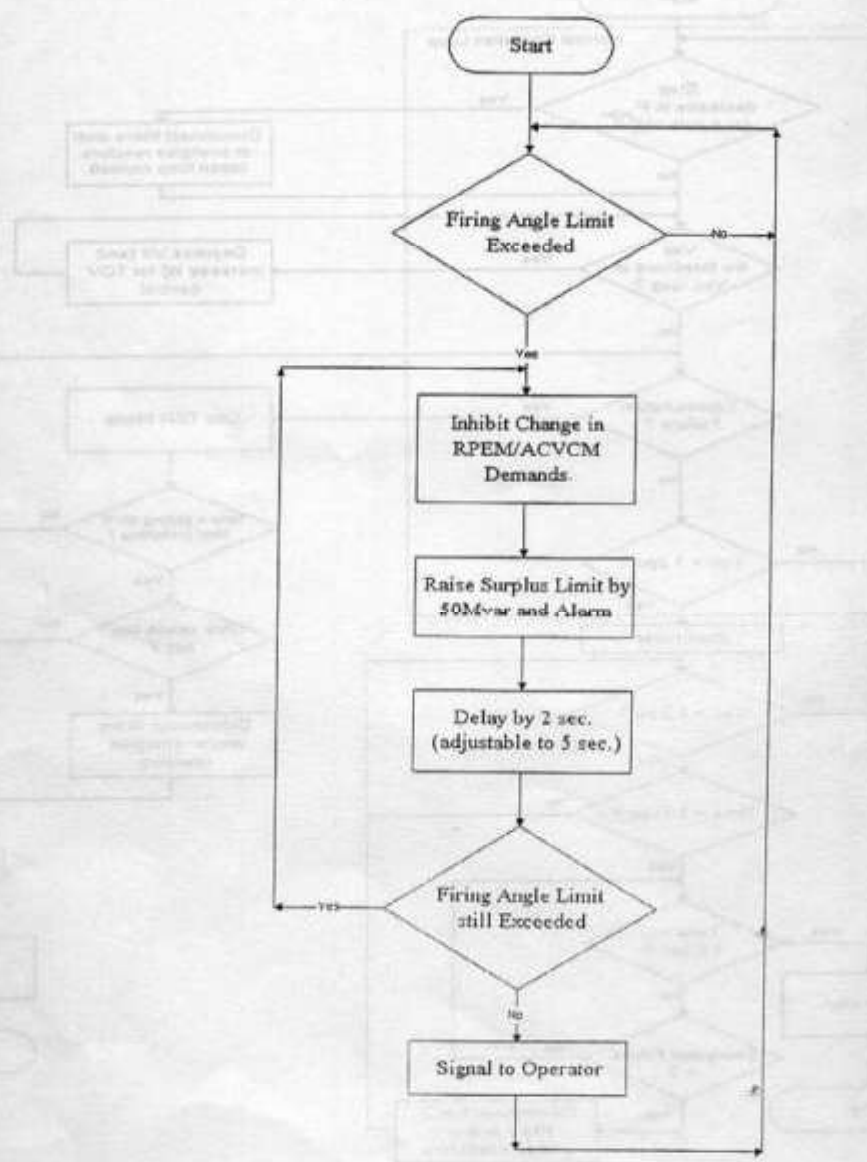


Figure 15 : Adverse Firing Angle Control

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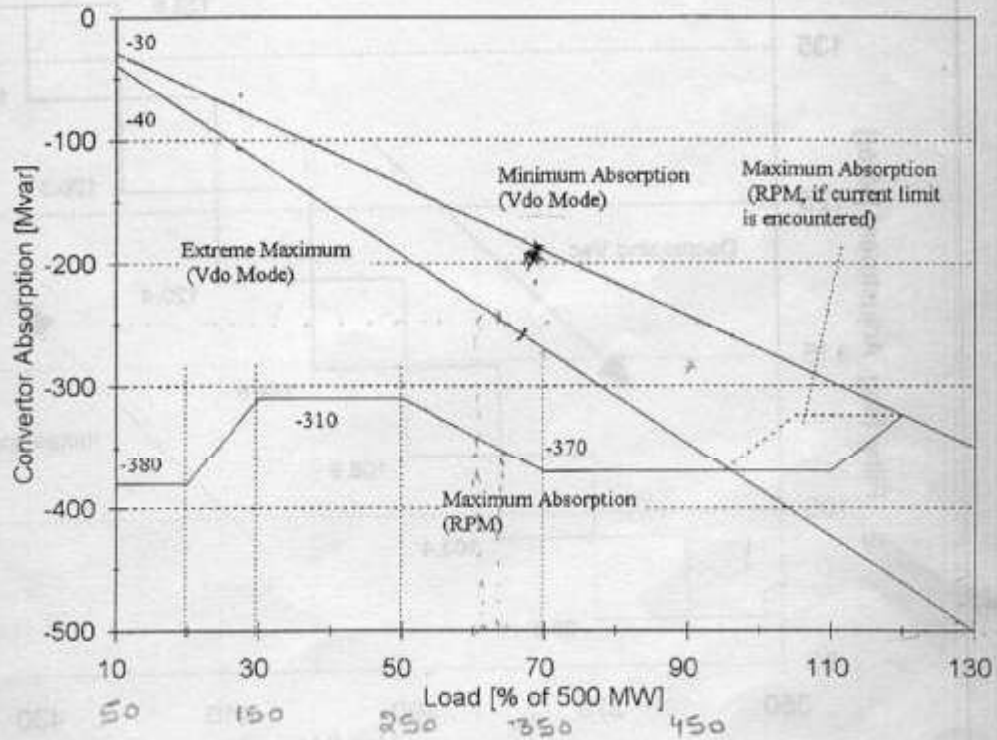


Figure 16: Converter Absorption Limit

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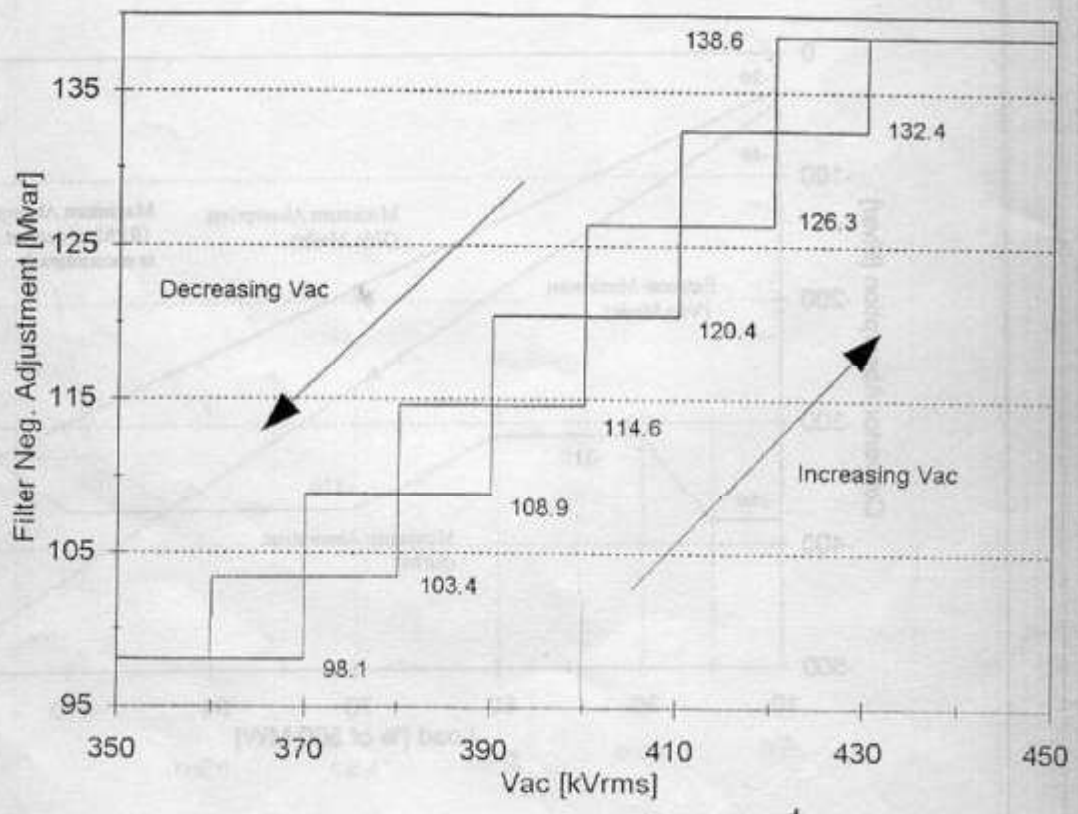


Figure 17: Adjustment to Negative Offset with AC volts

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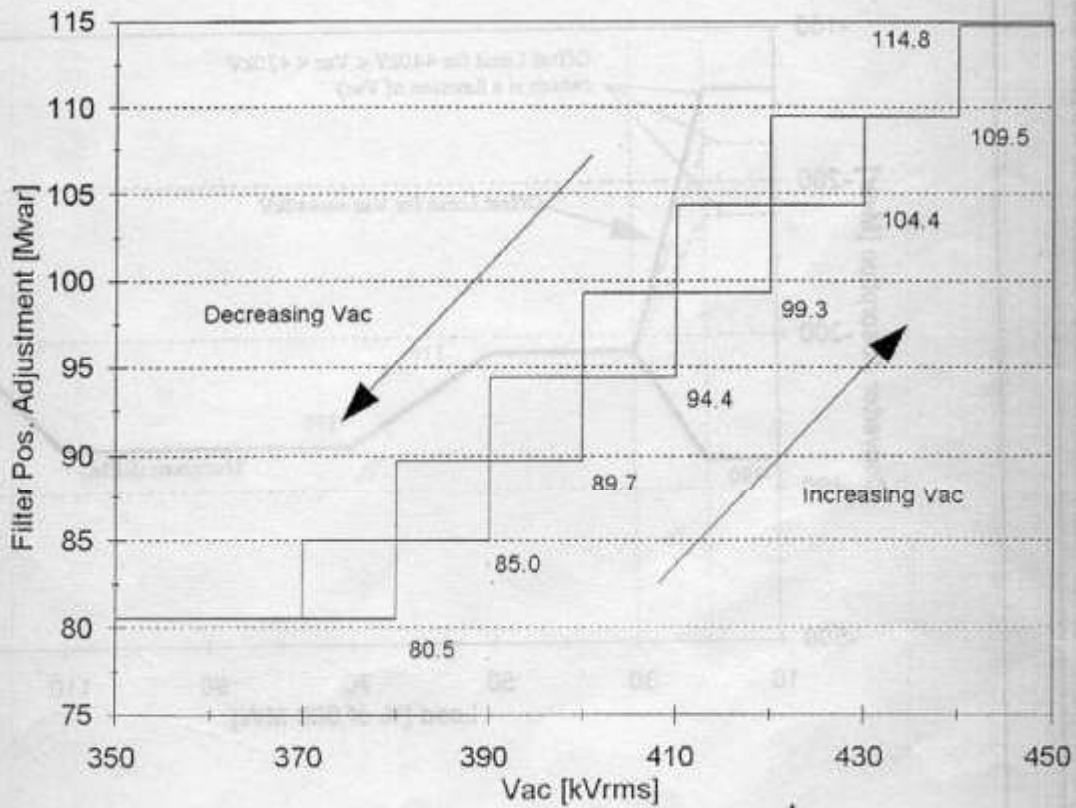


Figure 18 : Adjustment to Positive Offset with AC volts

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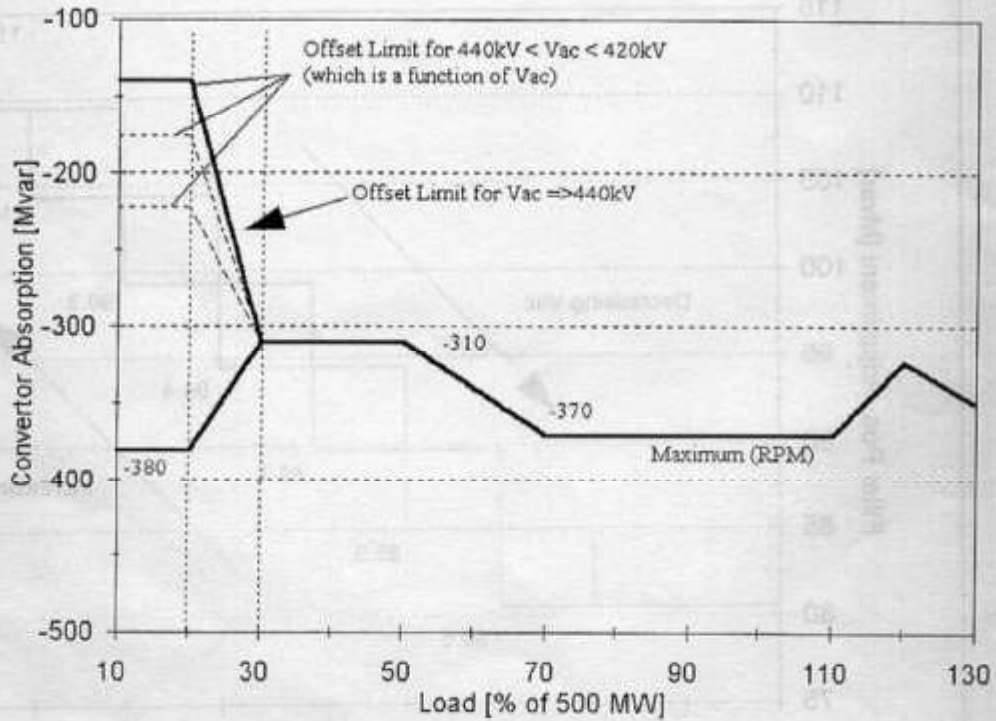


Figure 19: Variation in Maximum Absorption (RPM)

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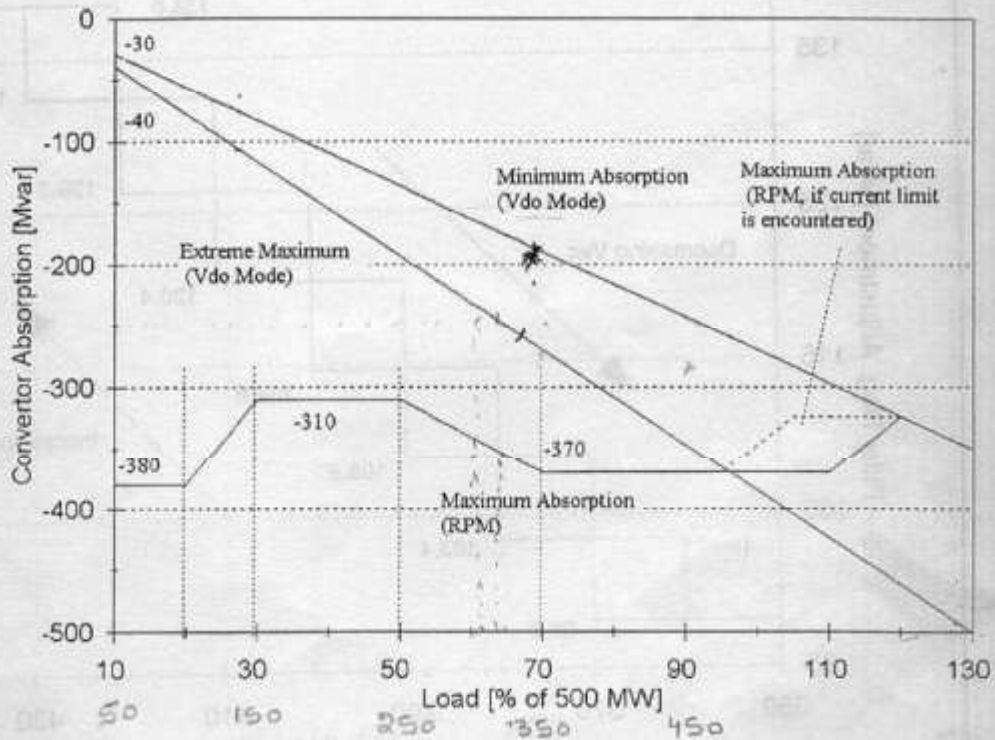


Figure 16: Converter Absorption Limit

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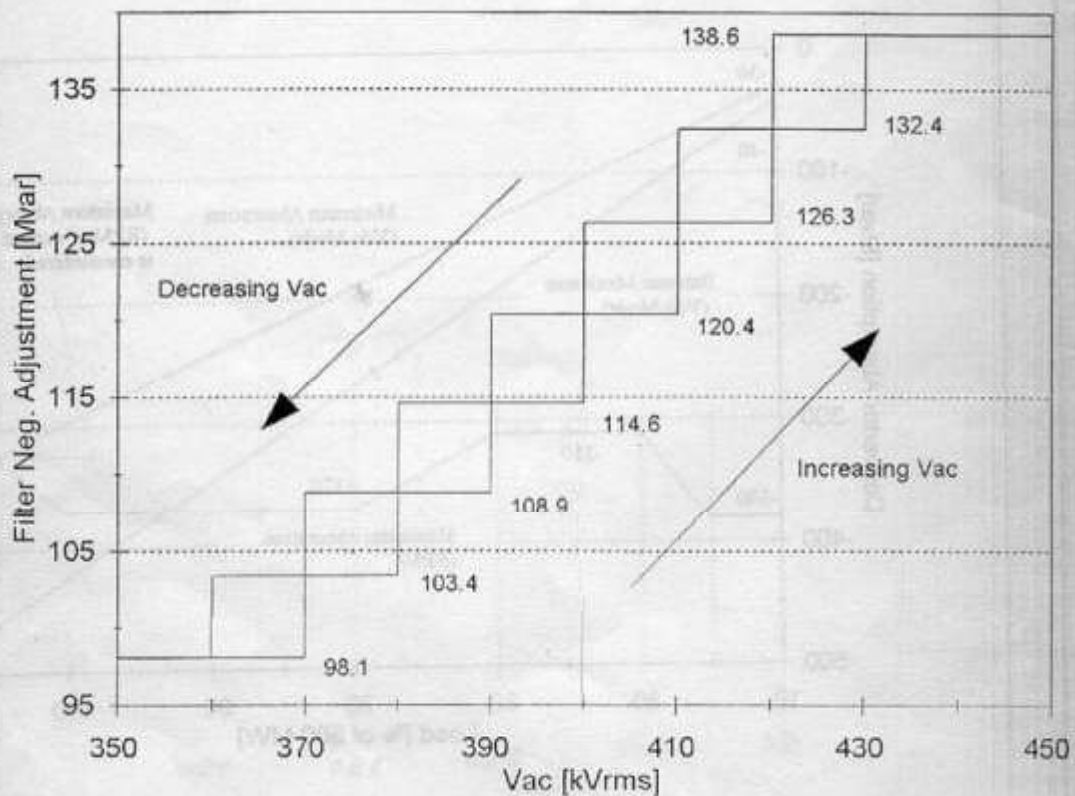


Figure 17: Adjustment to Negative Offset with AC volts

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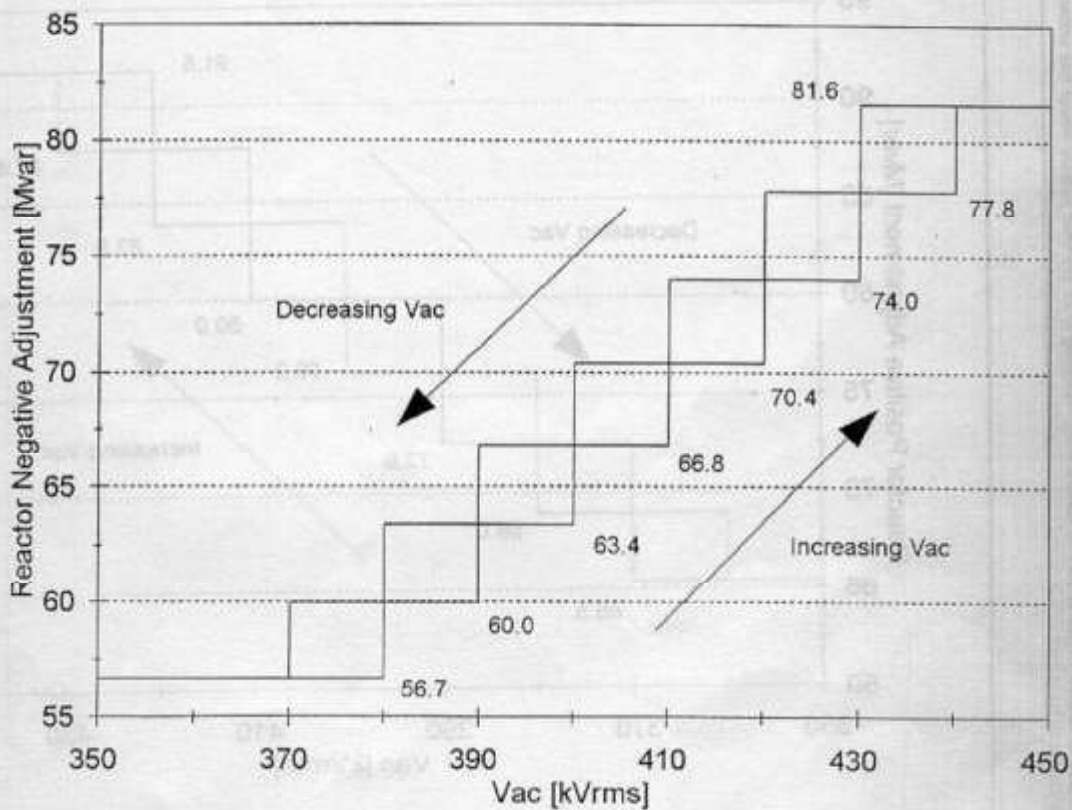


Figure 20: Reactor Negative Adjustment with AC volts

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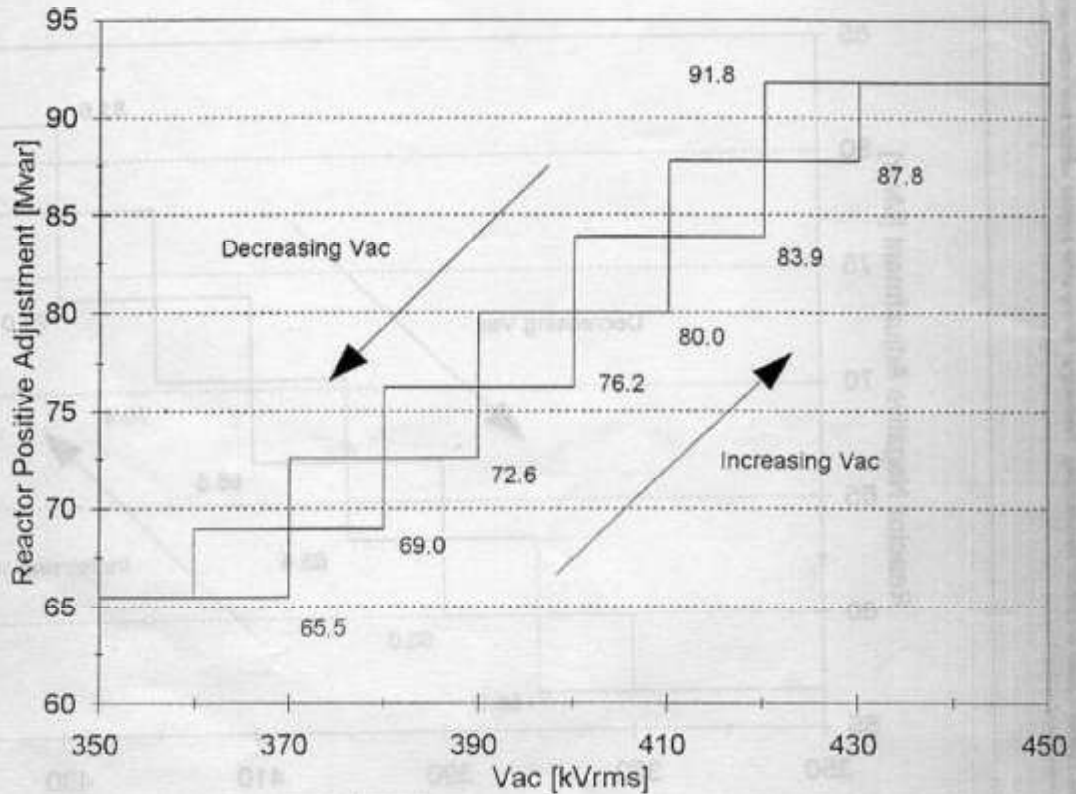
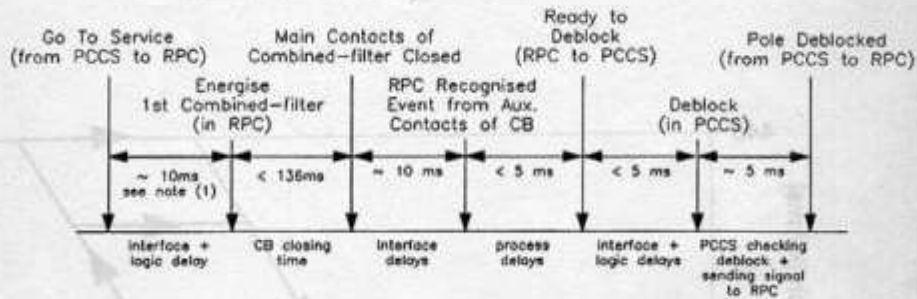


Figure 21: Reactor Positive Adjustment with AC volts

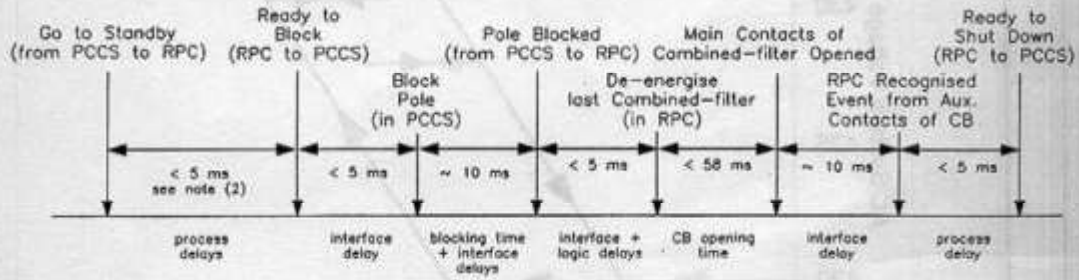
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DRM001C.SPC

Situation	Visakhapatnam	Customer	POWERGRID	Approved	BAR
Issue	^b 8.5.98	^c 14.4.99	^d	^e	^a
Approved	BTB	<i>MK</i>			



Timing Diagram for Deblocking



Timing Diagram for Blocking

- (1) The valve power supplies are charged up before PCCS sends "Go To Service" to RPC
- (2) The Power Order is reduced to minimum before PCCS sends "Go To Standby" to RPC

Figure 22 : Timing Diagrams for Deblocking/Blocking

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Title: Functional Specification
for Reactive Power Control

Ref. 730/CF0136/T06/
DRM001C.SPC

Original A 12.5.97

Situation	Visakhapatnam	Customer	POWERGRID	Approved	BAR
Issue	^a 8.5.98	^c 14.4.99	^d	^e	^f
Approved	BTB	<i>MK</i>			

Figure 23 : Not Used

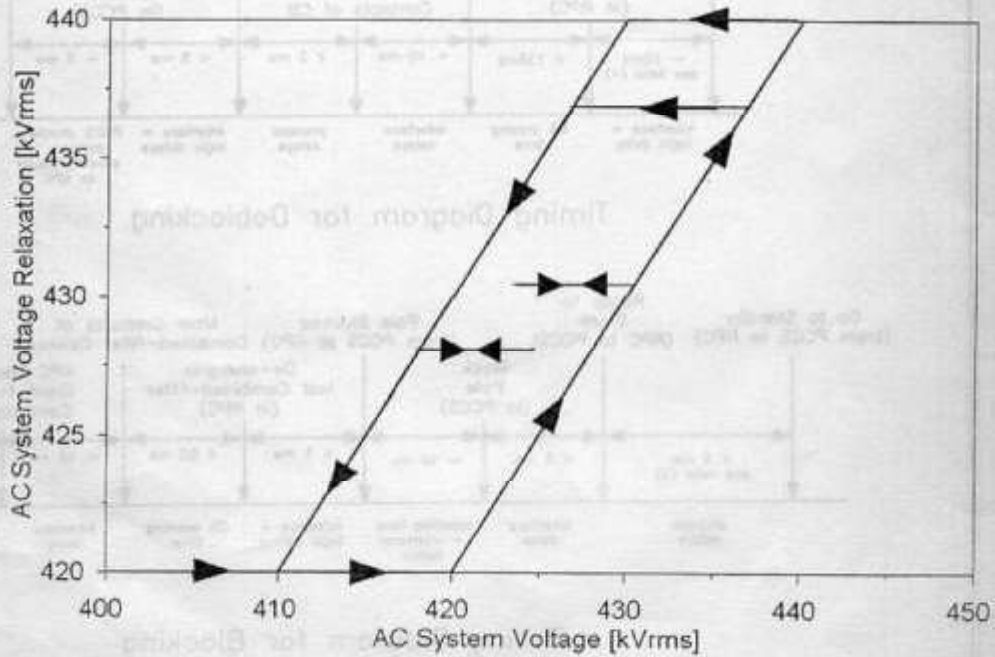


Figure 24 : Reactive Power Relaxation Characteristic for RPEM/ACVCM.

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MK

ATTACHMENT 1
Convertor Absorption Capability (Pd versus Vd)

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