



UNITED STATES
NUCLEAR REGULATORY COMMISSION

WASHINGTON, D.C. 20545-0001

February, 11, 1998

MEMORANDUM TO: Richard H. Wessman, Chief
Mechanical Engineering Branch
Division of Engineering

FROM: José A. Calvo, Chief *José A. Calvo*
Electrical Engineering Branch
Division of Engineering

SUBJECT: MOV TERMINAL VOLTAGE ISSUE PER GL 89-10 PROGRAM AT
SEQUOYAH NUCLEAR PLANT

During recent inspection activities to close out NRC review of the motor-operated valve (MOV) program at Sequoyah Nuclear Plant per GL 89-10, the NRC inspector noticed that the licensee assumed steady state voltage of 480.7 volts as the voltage available at the motor control center (MCC) for PORV Block Valves (FCV-68-332, -373). The inspector identified this as different from the voltage that might be calculated using the guidance provided in GL 89-10, Supplement 6. The Electrical Engineering Branch (EELB) was asked to review the acceptability of the licensee's justification of the operating voltages used in its GL 89-10 evaluation. The staff had several conference calls with the licensee on this issue. On January 30, 1998, the licensee provided its justification of the operating voltages used in GL 89-10 evaluations which was subsequently revised by the licensee on February 10, 1998, (see attachment).

The licensee stated that if an MOV is required to operate in automatic mode at the onset of a design basis accident, the MOV terminal voltage is evaluated to ensure that adequate voltage is available when the MOV is required to operate after the safety injection (SI) phase A or B signal is actuated. During this time the 161 kV offsite power supply is conservatively assumed to instantaneously drop from its normal operating voltage of 165 ± 1 kV to 153 kV (assuming worst case transmission system contingency) in conjunction with the block-load starting of all safety-related loads actuated by the SI phase A or B signal. As a result, the 6.9 kV shutdown board voltage will drop below the degraded voltage set point of 6456 volts to approximately 5850 volts. The licensee confirmed in a conference call on February 10, 1998, that the MOVs required to operate in automatic mode at the onset of a design basis accident, were conservatively evaluated with 6.9 kV shutdown board voltage below the degraded voltage set point of 6456 volts. We find that the licensee's approach is conservative and acceptable.

The licensee stated that for non-accident (manual-normal operation) MOVs (such as FCV-68-332 -373) that may need to start and operate after the accident starting transient is over, the steady state voltage attained due to the automatic load tap changer (LTC) action is utilized to ensure that adequate voltage is available. However, the GL 89-10, Supplement 6 recommends that the licensee use the degraded grid relay set point as the starting point for determining the

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minimum voltage at the motor terminals for ac motors. We have reviewed the licensee's justification of using higher voltage at the distribution buses. On the basis of our review, we find that the justification provided by the licensee for non-accident MOVs (manual-normal operation) is acceptable based on the following:

- 1) The automatic LTCs are provided on each low-voltage windings of the CSSTs. The taps will start after two seconds time delay and boost the voltage to approximately 1.25% each second until the voltage recovers within the LTC voltage range of 6997-7107 volts. The loss of one LTC will impact only one train of one unit. The loss of one LTC can be treated similarly as loss of degraded voltage relay protection on a single division.
- 2) 161kV offsite power supply is maintained at 165 ± 1 kV (refer to Procedure SWYD - 18, Rev. 15). The control room operator checks the 161kV offsite system voltage every shift and maintains the log. This procedure directs to comply with LCO 3.8.1.1, Action d (modes 1, 2, 3, 4) or LCO 3.8.1.2 (modes 5 and 6), if the offsite power system is not acceptable or the system cannot be brought within an acceptable range without exceeding the Unit 2 MVAR limit.
- 3) The unit's main generator does not trip until after 30 seconds into SI phase A or B event at which time its share of the voltage support to the local grid is lost. The instantaneous drop of 161 kV system with SI phase A or B event is therefore conservative relative to operation of automatic MOV which will actuate at the beginning of the event.

We conclude that the licensee's approach for determining the operating voltage for its safety-related MOVs is acceptable.

Attachment: As stated

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Attachment: As stated

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SEQUOIA NUCLEAR PLANT

**JUSTIFICATION OF OPERATING VOLTAGES USED IN GL89-10
EVALUATIONS**

The approach that is used by TVA in calculating the minimum expected voltage at the terminals of motor operated valves (MOV) in GL 89-10 program is as follows:

If a MOV is required to operate in automatic mode at onset of an design basis event, the MOV terminal voltage is evaluated to ensure that adequate voltage is available when the MOV is required to operate after the SI phase A or B signal. During this time period the 161kv offsite power supply is conservatively assumed to instantaneously drop from its normal operating voltage of 165 ± 1kv to 153kv (due to postulated worst case transmission system contingency) in conjunction with the block starting of all safety-related loads actuated by the SI phase A or B signal. As a result the 6.9kv Shutdown Board voltage will drop to below the degraded voltage setpoint of 6456 volts to approximately 5850 volts. The automatic load tap changers (LTC) on the Common Station Service Transformers (CSST) will start, after a 2 second time delay, boosting the voltage approximately 1.25% each second until the voltage recovers to within the LTC voltage range of 6997-7107 volts. The voltage will recover sufficiently to reset the degraded voltage relay (6595 volts) within 6 seconds.

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For non-accident (manual-normal operation) MOV's (such as for FCV-68-332, -333) that may need to start and operate after the accident starting transient is over, the steady-state voltage attained due to the automatic LTC action is utilized to ensure that adequate voltage is available. The lowest resulting voltage on any 6.9 Shutdown Board is approximately 6900 volts which still assumes the 161kv offsite power source at 153kv and results in the CSST LTC at its maximum boost voltage tap of 10%. The resulting 480v Reactor MOV Board voltages range from 477-480.7 volts which results in a minimum terminal voltage of 429 volts (93% of MOV rating) at any of the FCV-68-332, -333 MOV's.

The approach TVA has taken is consistent with IEEE 741-1997, "IEEE Standard Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations" Annex A, "Illustration of concepts associated with degraded voltage protection". IEEE 741 states "the capability to start motors must be evaluated... at or below the lowest expected preferred power supply voltage. If analysis determines that the bus voltage drops into the degraded voltage relay operating range during a momentary voltage dip, the voltage must recover above the reset value within the time delay period. Additionally, analyses may consider the effects of voltage compensating equipment, such as automatic load tap changing transformers, and automatic switched capacitor banks, including their associated time delays, to ensure bus voltage recovery following expected voltage transients". TVA has evaluated all starting motors at an offsite power supply voltage of 153kv, which is a bounding minimum preferred power supply voltage, and is based on Transmission System Studies (TSS) performed by Transmission/Planning Systems, which have been conservatively performed in accordance with the following criteria:

- Minimum grid voltage is established based on the worst-case combination of one postulated design basis event plus one unrelated simultaneous contingency to determine the availability, capacity, and capability of the offsite power sources to the nuclear units. The design basis event will always consist of an accident in one unit and simultaneous orderly shutdown (not unit trip) of all other units. This is because the accident case will always have the strictest voltage requirements in the plant voltage analyses (especially on the low voltage system). The

contingency will be the one single failure (or loss) of that part of the transmission system which gives the worst-case results. The selection of contingencies to be considered in the TSS's are in accordance with the guidelines presented in the North American Electric Reliability Council (NERC) standard on Transmission Planning.

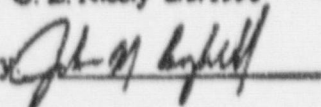
- All other transmission system components should be operating normally.

It should be noted that the 153kv assumption is very conservative and would take a pre-existing transmission system contingency plus a design basis event in Unit 2 plus a simultaneous worst case transmission system contingency plus an orderly shutdown of the other unit to drop to that level. For a design basis event plus a simultaneous worst case transmission system contingency with all other ties normal/closed, the 161kv system voltage would only drop to approximately 155kv.

The approach taken by TVA meets the guidelines of the GL 89-10 Action E Question 36, which state that "...licensees to use the voltage that will be present at the MOV when determining its ability of operate under design-basis conditions. This actual voltage applied to the MOV at the time of operation is often less than the nominal voltage rating of the MOV. Any voltage less than the nominal rating is referred to as degraded voltage". For the case of FCV-68-332, -333 the worst case calculated voltage present at the MOV at the time of operation is approximately 429 volts, which by the GL 89-10 statement above, is at a degraded voltage of 429 volts which is less than the MOV rating of 460 volts. The GL 89-10 document does not require showing that the MOV will operate at the degraded voltage relay setpoint, but at the voltage that will be present at the time of operation, which is the method TVA used.

TVA analyses conservatively used a greatly reduced offsite power supply voltage of 153kv (which is only possible due to a pre-existing transmission contingency plus a simultaneous transmission contingencies all at the same time with an accident in Unit 2 and an orderly shutdown of the other unit). Therefore it is not required to assume additional failures in the offsite power circuits, such as failure of the LTC's. It should be pointed out that, NRC Inspection Report 50-327/94-28 and 50-328/94-28 in 1994 documented a review which found acceptable the methodology for determining the minimum expected offsite voltage. The only GL 89-10 guideline is to be able to show the capability to start motors at or below the lowest expected preferred power supply voltage. TVA has conservatively met these guidelines for the GL 89-10 MOV's.

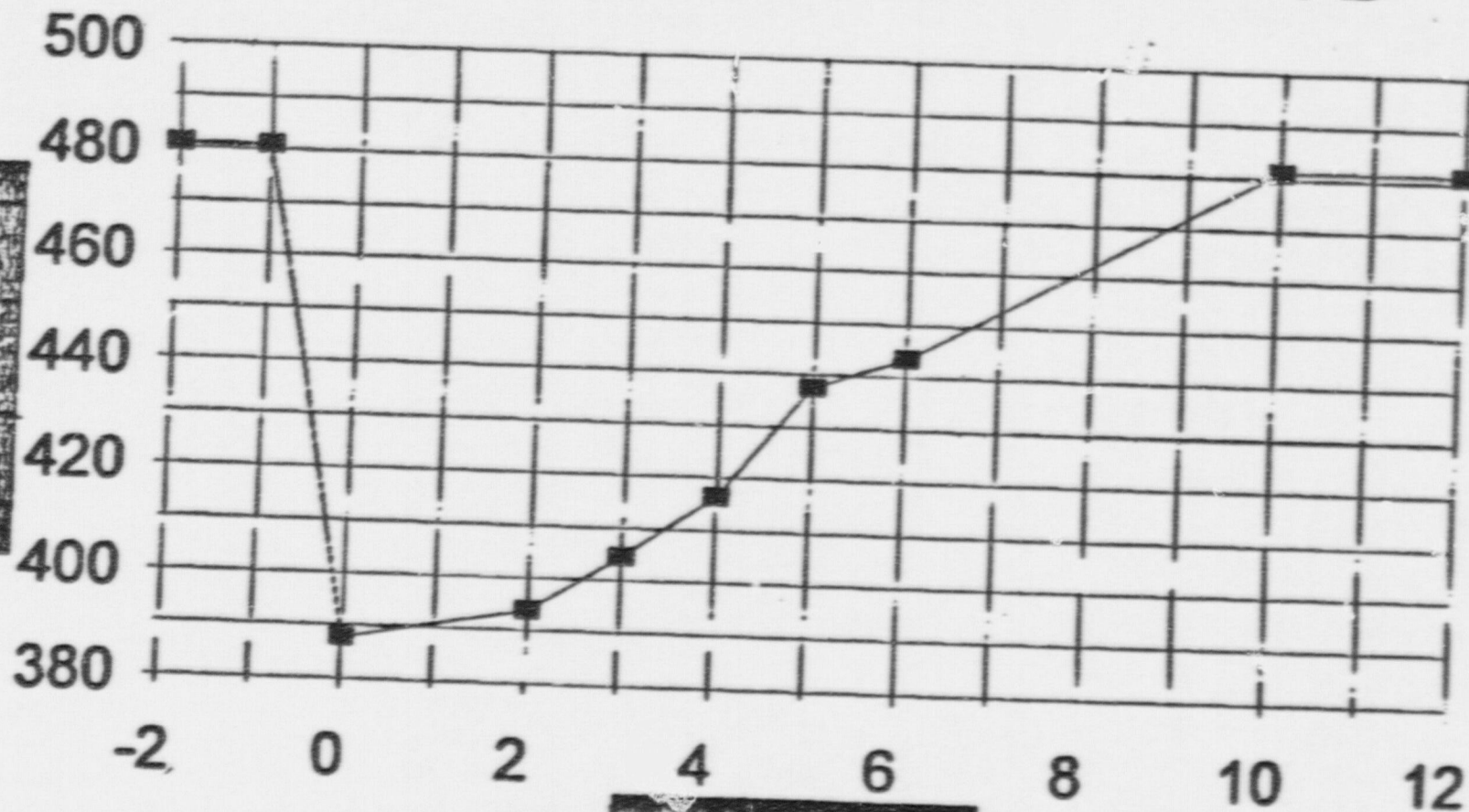
Prepared by: G. L. Nicely 2/9/1998

Reviewed by:  RJP

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480 V RX MOV BD 1B1-B

VOLTAGE PROFILE FOR SI-PH B



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JUSTIFICATION OF OPERATING VOLTAGES USED IN GL89-10 EVALUATIONS

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If a MOV is required to operate in automatic mode at onset of an design basis event, the MOV terminal voltage is evaluated to ensure that adequate voltage is available when the MOV is required to operate after the SI phase A or B signal. During this time period the 161kv offsite power supply is conservatively assumed to instantaneously drop from its normal operating voltage of 165 ± 1 kv to 153kv (due to postulated worst case transmission system contingency) in conjunction with the block starting of all safety-related loads actuated by the SI phase A or B signal. As a result the 6.9kv Shutdown Board voltage will drop to below the degraded voltage setpoint of 6456 volts to approximately 5850 volts. Therefore the MOV's required to operate in automatic mode at the onset of a design basis accident were conservatively evaluated with the 6.9kv Shutdown Board voltage below the degraded voltage setpoint of 6456 volts. The automatic load tap changers (LTC) on the Common Station Service Transformers (CSST) will start, after a 2 second time delay, boosting the voltage approximately 1.25% each second until the voltage recovers to within the LTC voltage range of 6997-7107 volts. The voltage will recover sufficiently to reset the degraded voltage relay (6595 volts) within 6 seconds.

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For non-accident (manual-normal operation) MOV's (such as for FCV-68-332, -333) or other loads that may need to start and operate after the transient is over, the steady-state voltage attained due to the automatic LTC action is utilized to ensure that adequate voltage is available. The lowest resulting voltage on any 6.9 Shutdown Board is approximately 6900 volts which still assumes the 161kv offsite power source at 153kv and results in the CSST LTC at its maximum boost voltage tap of 10%. The resulting 480v Reactor MOV Board voltages range from 477-480.7 volts which results in a minimum terminal voltage of 429 volts (93% of MOV rating) at any of the FCV-68-332, -333 MOV's.

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Prepared by: G. L. Nicolay 2/12/1998

Reviewed by: