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Application Strategy of Regulatory Guide 1.106 (Rev.2) for Long-Term Operation of Nuclear Power Plants

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1. Introduction

The U.S. NRC Regulatory Guide 1.106 (Rev.2), Thermal Overload Protection for Electric Motors on Motor-Operated Valves (2012), provides acceptable methods for applying thermal overload protection (TOP) devices in safety-related motor-operated valves (MOVs). The intent is to prevent needless interruption of safety functions while protecting motors from thermal damage.

However, many operating nuclear power plants were not originally designed in accordance with RG 1.106 (Rev.2), and significant design modifications are often difficult due to licensing and technical constraints. This paper proposes a practical application strategy focusing on operational and procedural measures, rather than extensive hardware modifications, for continued safe operation.

2. Background

Typical MOV motors are intermittent-duty, high-torque machines. During valve unseating or seating, motors experience high current, often 4–10 times the rated value, which may trigger overly conservative thermal overload devices.

RG 1.106 (Rev.2) outlines three regulatory positions:
1) Bypassing TOP depending on safety function immediacy,
2) Adjusting trip settings in favor of completing safety action, and
3) Providing control room alarms upon TOP trip.

While new plants may incorporate these requirements during design, existing plants must adopt a more pragmatic approach.

3. Practical Implementation Strategy

3.1 Trip Setting Adjustment
- Apply IEEE Std. 741-2007 Annex B criteria for calculating trip setpoints.
- Account for ambient temperature differences (up to 200°F between motor and relay).
- Resolve uncertainties in favor of safety function completion.
- Implement periodic verification tests.

3.2 Alarm Integration
- Provide control room alarm when a safety-related MOV trips TOP.
- This can often be realized with minimal I&C modification.

3.3 Stepwise Bypass Application
- For Group A MOVs, temporary bypass via operational procedure.
- For critical MOVs, selective automatic bypass using SBO/ESFAS signals.
- Ensure bypass does not compromise circuit protection, especially for small motors.

4. TOP Trip Setting Recalculation Checklist

4.1 Input Data Collection
- Motor rated current, locked rotor current (LRC), heating curve
- Valve load/torque characteristics, DP conditions
- Relay type, trip curve, tolerance data
- Installation ambient temperatures (motor vs relay location)

4.2 Trip Setting Calculation Steps
- Prioritize safety function completion over motor protection
- Estimate motor starting/unseating current duration
- Set relay trip curve above required stroke duration
- Apply ΔT correction (up to 200°F)
- Apply conservative tolerance (-5% to 0%)
- Verify against IEEE Std. 741-2007 Annex B

4.3 Verification and Testing
- Document calculation package (50.59 screening/evaluation)
- Perform functional tests (trip/recovery, alarm indication)
- Include periodic test plan for continued reliability

5. Conclusion

For existing nuclear power plants, strict compliance with RG 1.106 (Rev.2) may be impractical without major design changes. Instead, applying a classification-based approach, adjusting trip settings conservatively, and enhancing alarm functions provide a cost-effective and regulatorily defensible path to align with the guide's intent.

This strategy ensures continued plant safety while minimizing the burden of hardware modification, offering a practical model for gradual adoption in legacy facilities.

REFERENCES

[1] U.S. NRC, Regulatory Guide 1.106 (Rev.2), Thermal Overload Protection for Electric Motors on Motor-Operated Valves, Feb. 2012.
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