UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

FEB 3 1989

MEMORANDUM FOR: Edward L. Jordan, Chairman
Committee to Review Generic Requirements (CRGR)

FROM: Eric S. Beckjord, Director
Office of Nuclear Regulatory Research (RES)

SUBJECT: PROPOSAL TO EXPAND PERIODIC IN SITU TESTING AND SURVEILLANCE REQUIREMENTS FOR SAFETY-RELATED MOTOR-OPERATED VALVES (MOVs) (GENERIC ISSUE II.E.6.1, "IN SITU TESTING OF VALVES")

By my memorandum to you dated September 29, 1988, RES forwarded a proposed generic letter that addressed the subject issue. On September 9, 1988, the RES staff made a presentation to ACRS concerning the proposed generic letter. On September 22, 1988, the RES staff made a presentation to the ACRS Mechanical Components Subcommittee concerning the subject issue. On October 12, 1988, the CRGR reviewed the proposed generic letter (CRGR Meeting #148). On October 19, 1988, an open meeting was held at NRC at which NUMARC expressed their concerns regarding increased in situ testing of MOVs as described in the proposed generic letter. On October 27, 1988, the RES staff made a presentation before the ACRS Mechanical Components Subcommittee concerning the proposed generic letter and NUMARC made a separate presentation to the subcommittee.

On November 17, 1988, and on December 14, 1988, INEL presented results from the NRC sponsored test program in support of Generic Issue 87, "Failure of HPCI Steam Line Without Isolation." These tests involve attempts to close motor-operated valves against full-scale pipe-break blowdown forces. Several vendors of MOV signature-analysis diagnostic systems participated in these tests. Preliminary results of the test program, as characterized by INEL, indicate that industry sizing equations for at least some MOVs may not be conservative for all design basis conditions. Further, INEL indicated that some diagnostic systems may not predict conservative thrust values for the design basis conditions that were encountered, and possibly for other design basis conditions as well, including single-phase liquid flow.

The INEL conclusions and prospective NRC actions were discussed in staff meetings on December 1, 1988, and December 21, 1988. It was decided to proceed with the generic letter, based on the safety-significance of this issue and, thus, the need to provide guidance to the industry. NRC will provide additional information to industry based on the fully evaluated INEL test results and conclusions as they become available.

As a result of these meetings, as well as other staff comments, a number of changes were made to the proposed generic letter. Essentially, these were:

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1. The letter was rewritten in order to follow the first four action items of Bulletin 85-03 more closely. This was done in order to allow licensees to determine what work, performed in response to Bulletin 85-03, can be used to satisfy the recommendations of this letter.

2. Several types of specialized motor-operators such as those used to operate air dampers and weir gates are now explicitly excluded. There are few such components, and the standards for evaluation of design basis conditions are ambiguous. The potential effect on safety of these exclusions is considered to be negligible.

3. The CRGR suggestion that licensees may wish to increase surveillance of non-safety-related MOVs has been added to the letter.

4. A reference to NRC's maintenance policy is included. The recommendations of the letter are intended to be consistent with that policy.

5. As before, a list of deficiencies, degraded conditions and mis-adjustments is included; however, the list is now noted to be offered for guidance and not as a "check" list.

6. The recommendation for trending of MOV test and/or failure data includes a note that such data may be used to justify future schedule modifications.

7. NRC intent regarding alternatives to design basis pressure testing has been modified. In situ testing at degraded voltage is recognized as possibly not practical.

8. It is recommended that MOVs that are used to isolate primary system pipe breaks outside containment be scheduled for test in the latter phases of the program, because these MOVs are the subject of ongoing research.

9. Wording was revised to clarify that alternative implementation schedules will be considered by NRC on a case-by-case basis.

10. The schedule to accomplish initial testing (item 1.) was extended so as to be completed within 5 years/3 refueling outages rather than 3 years/2 refueling outages. This is based on estimates of available industry resources and recognition that testing should start after program setup (item k.).

11. Licensees are allowed 6 months rather than 90 days in order to make an initial reply based on the possibility for alternative proposals and schedules.

12. Estimate of licensee burden hours was increased from 200 hours to 2000 hours in recognition of the licensee's need to study alternative testing options and schedules prior to an initial reply to NRC.

13. An attachment to the letter that describes alternatives to full-flow or full pressure testing was eliminated. It was decided that it is not appropriate for NRC to provide such guidance. The licensees are responsible for assuring operability of safety-related components and are therefore responsible for determining adequate procedures for testing.

We had originally intended to offer a marked-up copy as a guide to the changes that were made. However, the changes in format from our previous submittal were so extensive that this was not practical.

Your consideration of this matter is requested within two weeks in order to meet our schedule. Please inform us if the CRGR desires to have another meeting to discuss, in more detail, the changes we made to the proposed generic letter.

Eric S. Beckjord, Director
Office of Nuclear Regulatory Research

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Enclosure: As stated

Enclosure 1
DRAFT GENERIC LETTER
Proposal to Expand Periodic In Situ Testing and
Surveillance Recommendations for Safety-Related Motor-Operated Valves (MOVs)

TO: All holders of nuclear power reactor operating licenses (OLs) or construction permits (CPs). (To be referred to as licensees)

SUBJECT: SAFETY-RELATED[1] MOTOR-OPERATED VALVE TESTING AND SURVEILLANCE

Bulletin 85-03, dated November 15, 1985, and Supplement 1 of Bulletin 85-03, dated April 27, 1988, recommend that licensees develop and implement a program to assure that valve motor-operator switch settings (torque, torque bypass, position limit, overload) for motor-operated valves (MOVs) in several specified systems, are selected, set and maintained so that the MOVs will operate under design basis[2] conditions for the life of the plant. NRC assessments of the reliability of all safety-related MOVs, based on extrapolations of the currently available results of valve surveillance performed in response to Bulletin 85-03, indicate that the program to verify switch settings must be extended in order to assure operability of all safety-related fluid systems. Our evaluation of the data indicates that, unless additional measures are taken, failure of safety-related MOV's to operate under design basis conditions will occur much more often than had been previously estimated.

The ASME Code, Section XI stroke-timing test for MOVs, that is currently performed to meet the inservice testing requirements of 10 CFR 50.55a(g), is not sufficient to provide assurance of MOV operability at design basis conditions. Such assurance of design basis operability is necessary in order to meet the requirements outlined in General Design Criteria 1, 4, 18, and 21 of Appendix A to 10 CFR 50 and Criterion XI of Appendix B to 10 CFR 50.

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[1] The term "safety-related" refers to those systems and components that are relied upon to remain functional during and following design basis events to ensure (i) the integrity of the reactor coolant pressure boundary, (ii) the capability to shut down the reactor and maintain it in a safe shutdown condition, and (iii) the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures comparable to the 10 CFR Part 100 guidelines. (See 10 CFR 50.49)

[2] Design basis events are defined as conditions of normal operation, including anticipated operational occurrences, design basis accidents, external events, and natural phenomena for which the plant must be designed to ensure functions (i) through (iii) above. (See 10 CFR 50.49)

By this letter NRC extends the scope of the program outlined in Bulletin 85-03 and Supplement 1 of Bulletin 85-03 to include all safety-related MOVs.[3] The recommended program will provide for MOVs to be tested, inspected, and maintained so as to provide the necessary assurance that they will function when subjected to the design basis conditions that will be encountered during both normal operation and abnormal events within the design basis of the plant.

The nuclear power industry has several generic activities ongoing in the area of motor-operated valve maintenance and testing. For example, EPRI is to publish a maintenance guide as well as an applications guide for MOVs. The results of these efforts should be useful to individual plant licensees in following the recommendations contained herein.

The NRC suggests that licensees also consider increased surveillance of MOVs that are not safety-related.

Assurance of MOV operability is a complex topic. It involves many factors such as development of strong testing and maintenance programs, management support and coordination of engineering, maintenance and testing. This effort should be viewed by all concerned as a long-term ongoing program. Licensees that have already performed extensive programs on MOVs have found it very beneficial and cost-effective to require that all maintenance and adjustments on the MOVs be performed by technicians that have received specific training in that regard.

Surveillance, adjustment, maintenance and repair of safety-related MOVs should be performed in accordance with quality assurance program methods that meet the requirements of 10 CFR 50. The following recommended actions are intended to be consistent with licensee's maintenance programs and with NRC's maintenance policy as published in the Federal Register on March 23, 1988.

The program to respond to this letter should contain items a. through j. below. Items a., b., c. and the first paragraph of d., are repeated, with editorial changes, from Bulletin 85-03 or from Supplement 1 of that bulletin. The second paragraph of item d. and items e., f., and g. provide additional clarification and guidance.

a. Review and document the design basis for the operation of each MOV. This documentation should include the maximum differential pressure expected during both opening and closing the MOV for both normal operations and

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[3] MOVs that are used for air control in heating and ventilating service and not involved in containment isolation may be excluded. Other unique applications of safety-related motor operators such as weir gates, or other applications that are not part of conventional piping systems, may be considered for exclusion. All such exclusions should be explained and documented in accordance with the program outlined in the following action items.

abnormal events, to the extent that these MOV operations and events are included in the existing approved design basis. The design basis is that documented in pertinent licensee submittals such as FSAR analyses and approved operating procedures and emergency procedures.

In addition, when determining the maximum differential pressure for valves that can be inadvertently mispositioned, the fact that the valve must be able to recover from such mispositioning should be included. Any motor-operated valve that is not blocked from inadvertent operation from either the control room, the motor control center, or the valve itself should be considered capable of being mispositioned (referred to hereafter as position-changeable MOVs).

b. Using the results from item a. above, establish the correct switch settings. This should include establishing a program to review and revise, as necessary, the methods for selecting and setting all switches (i.e., torque, torque bypass, position limit, overload) for each valve operation (opening and closing).

The intent is to provide assurance that a program exists for selecting and setting valve operator switches to ensure high reliability of safety system MOVs. (See item f. for further guidance.)

c. Individual MOV switch settings should be changed, as appropriate, to those established in item b. above. Whether the switch settings are changed or not, the MOV should, if practical, be demonstrated to be operable by testing the MOV at the design basis differential pressure and/or flow determined in item a. above with the exception that testing MOVs under conditions simulating a break in the line containing the MOV is not required. An explanation should be documented for any cases where testing with the design basis differential pressure or flow cannot practicably be performed. This explanation should include a description of the alternatives to design basis differential pressure testing or flow testing that will be used to verify the correct settings.

Note: This letter is not intended to establish a recommendation for valve testing for the condition simulating a break in the line containing the valve. (See item g. for further guidance.)

Each MOV should be stroke tested, to the extent practical, to verify that the settings defined in item b. above have been properly implemented even if testing with differential pressure or flow cannot be performed.

d. Prepare or revise procedures to ensure that correct switch settings are determined and maintained throughout the life of the plant. Ensure that applicable industry recommendations are considered in the preparation of these procedures. This is intended to be completely consistent with action item 3.2, "Post-Maintenance Testing (All Other Safety-Related

Components)," of Generic Letter 83-28, "Required Actions Based on Generic Implications of Salem ATWS Events." These procedures should include provisions to monitor MOV performance to ensure the switch settings are correct. This is particularly important if the torque or torque bypass switch setting has been significantly raised above that required.

It may become necessary to adjust MOV switch settings because of the effects of wear or aging. Therefore, it is insufficient to merely verify that the switch settings are unchanged from previously established values. The switch settings should be verified, in accordance with the program implementation and verification schedule outlined below, to be appropriate for the condition of each MOV. The ASME Code Section XI stroke-timing test required by 10 CFR 50 is not sufficient to satisfy the intent of this action item. The switch settings need not be verified each time the ASME Code stroke-timing test is performed.

e. Regarding item a., no change to the existing plant design basis is intended and none should be inferred. The design basis review should not be restricted to a determination of estimated maximum design basis differential pressure. The design basis review should include an examination of the pertinent design and installation criteria that were used in choosing the particular MOV. For example, the review should include the effects on MOV performance of design basis degraded voltage, including the capability of the MOV's power supply and cables to provide the high initial current needed by the MOV to operate,

f. Regarding iter b., actions should be taken in accordance with the appropriate portions of the plant's technical specifications if either (1) changing the switch settings is not sufficient to ensure MOV operation under the design basis conditions or (2) the assessments of the necessary changes to the switch settings indicate that the MOV, as presently adjusted, may not be capable of operating under the design basis conditions (i.e., not operable). Records of causes of inoperability and corrective actions taken should be retained as part of the required records (10 CFR 50 and the license commitment) for each MOV, and should be made available for NRC audit on request. The licensee may also elect to implement additional actions, such as administrative or procedural controls or equipment modifications in order to minimize the likelihood of MOV malfunction.

g. Documentation of explanations and description of actual test methods used in item c. should be retained as part of the required records for the MOV and should be made available for NRC audit on request.

As stated in item c., there is no intent to test at a condition simulating a break in the line containing the MOV. However, to the extent that such MOV operation is relied upon in the design basis, a break in the line containing the MOV should be considered in the analyses described in action items a. and b. above. The design basis for certain normally open

primary system MOVs (for example, serving RWCU and steam supply to HPCI and RCIC turbines in BWRs) demands that these MOVs close to isolate the largest postulated downstream pipe break outside containment. These MOVs are currently the subject of a full-scale blowdown flow testing program being performed by Idaho National Engineering Laboratory (INEL) under sponsorship by the NRC. Preliminary results of those tests indicate that some MOVs may be subjected to mechanisms and loads that were not previously accounted for. INEL's preliminary conclusions indicate that industry sizing equations for MOVs that must perform this type of safety related function may not be conservative for all design basis conditions. NRC recommends that such MOVs be scheduled for tests in the latter phases of the licensee's program.

In addition, INEL has concluded that some diagnostic systems cannot predict conservative thrust values for the design basis differential pressure conditions that were modeled in the tests and possibly for other design basis conditions as well. Specifically, based on INEL's preliminary conclusions, it is not clear that tests of an MOV at low or moderate pressure differentials can be directly extrapolated to determine correct switch settings at design basis differential pressure using diagnostic techniques, even for single-phase liquid flow. Therefore, the only known technically acceptable method of determining switch settings is to perform testing at or near the design basis differential pressure, either in situ or on prototype valves.

However, as recognized in item c., demonstrating MOV operability at design basis differential pressure is not practical for some MOVs. Alternatives to testing at design basis differential pressure that industry has used includes testing at low differential pressure and/or low flow, as appropriate, combined with MOV surveillance using suitable signature analysis diagnostic techniques. Licensees should assure that any tests conducted using diagnostic techniques, along with differential pressure lower than design basis differential pressure, will yield sufficiently conservative results to assure design basis operability of safety-related MOVs.

Licensees should also be aware that increasing MOV thrust by increasing torque switch settings in order to satisfy design basis operability considerations may subject the valve components to increased forces when the MOV is operated at no-load or low-load conditions. Such conditions should be evaluated by the licensee to assure that MOV operability is not compromised. The NRC will provide additional information on MOV performance under full-scale blowdown test conditions from INEL's tests as those results become available. Licensees are specifically cautioned, however, that the INEL tests are not directed toward determining the capability and limitations of various MOV diagnostic systems. Therefore, licensees are also encouraged to consider the need for industry sponsored MOV test programs to assure that diagnostic techniques can be used to determine the correct switch settings to assure operability of those safety-related MOVs for which it is not practical to test at design basis differential pressure.

It is also recognized that it may be impractical to perform in situ MOV testing at design basis degraded voltage conditions. However, the switch settings established in item b. above should at least be established to account for the situation where the valves may be called upon to operate at design basis differential pressure, or flow, and under degraded voltage conditions.

If the licensee failed to consider degraded voltage or power supply or cable adequacy for MOVs in systems covered by Bulletin 85-03, the design review and establishment of switch settings for those MOVs should be reevaluated.

h. A number of deficiencies, misadjustments and degraded conditions were discovered by licensees, either as a result of their efforts to comply with Bulletin 85-03 or from other experiences. A list of these conditions (including improper switch settings) is included in Attachment A to this letter. The program described in this letter should be established by the licensee so as to allow for identification, to the extent practical, of such conditions, if present. The list contained in Attachment A is intended for guidance. It is neither all-inclusive nor is it intended to serve as a "check" list for inspection.

i. All MOV failures as well as actions taken, including repairs, alterations, analyses, test, and surveillance, should be analyzed or justified and documented for each MOV. The documentation should include results and history of each as-found deteriorated condition, malfunction, test, inspection, analysis, repair, or alteration. All documentation should be retained as part of the required records and should be made available for NRC audit upon request.

j. The documentation that is collected in order to comply with action i. should be periodically (at least every 2 years or after each refueling outage after program implementation) examined in order to establish trends of MOV operability. These trends could provide the basis for a licensee proposed revision to the testing frequency established to periodically verify the adequacy of MOV switch settings (see action items d. and m.). All documentation should be retained as part of the required records and should be made available for NRC audit upon request. It is suggested that licensees may desire to share this information, and therefore, it is further suggested that licensees produce this information in a standardized format in order to expedite information exchange.

The program to respond to this letter should be accomplished in accordance with the schedule outlined in action items k. through n.

Alternative schedules to those recommended below should be forwarded to the NRC. Any alternative schedule for action item l. should include specific schedules for evaluating and testing each MOV. The scheduled dates should provide for accomplishing item c. soonest for those MOVs that the licensee considers to have the greatest impact on plant safety. Any alternative

schedule for action item m. should provide for verification of MOV operability after maintenance or adjustment (including packing adjustment). A description of any proposed alternative schedule and supporting justification should be included in the response required by action item o.

k. For plants with an OL, the documentation outlined in this action item should be available for NRC audit within 2 years or one refueling outage of the date of this letter, whichever is later. For plants with a CP, the documentation outlined in this action item should be available for NRC audit within 2 years of the date of this letter or prior to OL issuance, whichever is later. The documents should include:

   1. The description and results of the design basis review outlined in action item a. (including guidance from item e.) for all safety-related MOVs, and position-changeable MOVs as described, and

   2. The description of the program to accomplish items b. through d. and f. through j. for all safety-related MOVs and position-changeable MOVs.

l. Each licensee with an OL should accomplish all analyses, verifications, tests, and inspections that have been instituted in order to comply with action items a., b., c., (including supplemental guidance in items d., e., f., g, and h.) within 5 years or three refueling outages of the date of this letter, whichever is later. Each licensee with a CP should accomplish these actions within 5 years of the date of this letter or prior to OL issuance, whichever is later.

m. The program for verification of switch settings outlined in action item d., as well as other tests or surveillance that the owner may choose to use to identify potential MOV degradations or misadjustments, as outlined in action item h., should be accomplished after maintenance or adjustment (including packing adjustment) of each MOV, and periodically thereafter, at least every three years or every second refueling outage, whichever is longer.

n. In recognition of the necessity for pre-planning, refueling outages that start within six months of the date of this letter need not be counted in establishing the schedule to meet the time limits recommended in these action items.

Pursuant to 10 CFR 50.54(f), licensees are required to provide information to NRC as outlined in action items o., p., and q. below.

o. Licensees are required to advise NRC in writing, within 6 months of the date of this letter, whether the above schedule and recommendations will be met. For any date or recommendation that cannot be met, the licensee shall advise the NRC in writing of a revised date or alternative action along with an explanation. The licensee should also submit any future

changes to scheduled commitments on the basis of trending results (see item j.). These revised schedules and alternative actions may be implemented without NRC approval. Justification of the revised schedules or alternative actions should be retained on-site for possible future inspection.

p. Licensees are required to notify NRC in writing within 30 days after action item k. has been accomplished.

q. Licensees are required to notify NRC in writing within 30 days after action item l. has been accomplished.

This generic letter is intended to supersede the recommendations contained in Bulletin 85-03 and its supplement. Bulletin 85-03 addressees need not make any further responses regarding that bulletin or its supplement. The information which would have been submitted to NRC in response to Bulletin 85-03 or its supplement should be retained in accordance with the recommendations of this generic letter.

Documented results of tests or other surveillance that were used to satisfy the recommended actions of Bulletin 85-03, the supplement to that bulletin, or a voluntary extension of the recommendations in those documents to other safety-related valves may be used, to the extent applicable, to satisfy the recommendations stated herein.

This request is covered by Office of Management and Budget Clearance Number 3150-001 which expires December 31, 1989. The estimated average burden hours is 2000 man-hours per licensee response, including assessment of the new recommendations, searching data sources, gathering and analyzing the data, and preparing the required letters. These estimated average burden hours pertain only to the identified response related matters and do not include the time for the actual implementation of the requested actions. Comments on the accuracy of this estimate and suggestions to reduce the burden may be directed to the Office of Management and Budget, Room 3208, New Executive Office Building, Washington D.C. 20503, and the U.S. Nuclear Regulatory Commission, Records and Reports Management Branch, Office of Administration and Resources Management, Washington, D.C. 20555.

If you have any questions regarding this matter, please contact the NRC project manager or the technical contact listed below.

Dennis Crutchfield
Acting Associate Director for Projects
Office of Nuclear Reactor Regulation

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"Draft generic letter MOV"

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Attachment A of Generic Letter
Summary of Common Motor-Operated Valve Deficiencies,
Misadjustments, and Degraded Conditions

1. Incorrect torque switch bypass settings
2. Incorrect torque switch settings
3. Unbalanced torque switch
4. Spring pack gap or incorrect spring pack preload
5. Incorrect stem packing tightness
6. Excessive inertia
7. Loose or tight stem-nut locknut
8. Incorrect limit switch settings
9. Stem wear
10. Bent or broken stem
11. Worn or broken gears
12. Grease problems (hardening, migration into spring pack, lack of grease, excessive grease, contamination, non-specified grease)
13. Motor insulation or rotor degradation
14. Incorrect wire size or degraded wiring
15. Disk/seat binding
16. Water in internal parts or deterioration therefrom
17. Motor undersized (for degraded voltage conditions or other conditions)
18. Incorrect valve position indication
19. Misadjustment or failure of handwheel declutch mechanism
20. Relay problems (incorrect relays, dirt in relays, deteriorated relays, miswired relays)
21. Incorrect thermal overload switch settings
22. Worn or broken bearings.
23. Broken or cracked limit switch and torque switch components
24. Missing or modified torque switch limiter plate
25. Improperly sized actuators
26. Hydraulic Lockup
27. Incorrect metallic materials for gears, keys, bolts, shafts, etc.
28. Degraded voltage (within design basis)
29. Defective motor control logic
30. Excessive seating or backseating force application
31. Incorrect reassembly or adjustment after maintenance and/or testing
32. Unauthorized modifications or adjustments