VERMONT YANKEE
NUCLEAR POWER CORPORATION

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REPLY TO:
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April 13, 1988
FVY 88-028

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

References:
(a) License No. DPR-28 (Docket No. 50-271)
(b) Letter, VYNPC to USNRC, FVY 87-107, "Proposed Change to the Vermont Yankee Technical Specifications - Logic System Functional Test Intervals," dated November 30, 1987
(c) Letter, VYNPC to USNRC, FVY 88-04, "Clarification to Vermont Yankee Proposed Change No. 142 - Logic System Functional Test Intervals," dated January 20, 1988
(d) Letter, USNRC to VYNPC, NVY 88-041, "Meeting Summary," dated March 17, 1988

Subject: Additional Information in Support of Vermont Yankee Proposed Change No. 142 - Logic System Functional Test Intervals

Dear Sir:

By letter dated November 30, 1987 [Reference (b)], Vermont Yankee submitted the subject proposed change to revise the Technical Specifications for trip system logic functional testing intervals as a result of the expanded testing methodology incorporated during the 1987 refueling outage. Pursuant to a recent discussion with the NRC staff associated with the review of the subject amendment request, Vermont Yankee has been requested to provide the information supporting our technical presentation during the March 15, 1988 meeting with the staff [Reference (d)]. Specifically, the staff has requested additional information regarding equipment (relay) reliability.

In accordance with the staff's request, we herewith provide, as Enclosure 1 to this letter, the information supporting Vermont Yankee's technical presentation at the March 15, 1988 meeting concerning relay reliability.

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Should you have any questions or require further information concerning this matter, please contact this office.

Very truly yours,

VERMONT YANKEE NUCLEAR POWER CORPORATION

R. W. Capstick

R. W. Capstick
Licensing Engineer

RWC/25.525

Enclosure

cc: USNRC - Office of NRR
Mr. Vern Rooney, Senior Project Manager
Project Directorate I-3

USNRC
Region I

USNRC
Resident Inspector

ASLB Service List

ENCLOSURE 1

VERMONT YANKEE RELAY RELIABILITY SUMMARY

During the March 15, 1988 presentation at NRC offices concerning the Vermont Yankee (VY) proposed Technical Specification change for Logic System functional test intervals, VY discussed the reliability of the relays utilized for these logic operations. The following supplemental information is provided in response to NRC's March 31, 1983 request:

Review of Vermont Yankee-Specific Relay Failures

In an attempt to determine the reliability of relays utilized at VY within safety systems, a documentation review was performed to identify the number of relay failures experienced at VY. The following documents which identify relay failures were reviewed:

- Past Results of Logic System Functional Tests
- License Event Reports (LERs)
- Potential Reportable Occurrences (PROs)

Review of LERs and PROs extended as far back as 1980. All three of the above documents were reviewed for the years 1983 through 1987. The attached table (Table 1) summarizes the results of these reviews for the past five years (1983 through 1987).

Although a combination of General Electric HFA, and HGA relays make up the majority of the relays installed in safety systems, the documentation review addressed failures of any type of relay utilized at VY. A total of eight failures over the five-year period were identified for all relays (approximately 500) installed in safety systems at VY, reflecting the excellent reliability of this equipment. These failures included only 1 HFA relay and 0 HGA relays. Further, the following considerations apply:

- Five out of the eight failures involved timing relays. This type of failure does not necessarily mean that the required functions would have failed. It could mean that required functions would be performed, but either earlier or later than administrative or Technical Specification limits.

- Three out of the eight failures were relays which were normally energized. These relays are designed to fail in the "safe direction." In all three cases, relays failed as-designed. In addition, these relays are the only relays out of the eight failures which were not timing relays.

- Two of the failed relays are not within the set of relays for which the proposed amendment would alter testing requirements.

- All the relay failures were determined not to have adverse safety implications.

Review of Generic Relay Reliability

To summarize, our review concerning the generic reliability of relays as discussed on March 15, 1988 involved reviewing the following documents:

- "Nuclear Plant Reliability Data System (NPRDS) Search for HFA and HGA Relays."

- NEDC-30851P, "Technical Specification Analysis for BWR Reactor Protection System," by General Electric, dated May 1985 (HFA relays).

Results of both generic reviews indicated that subject relays have an excellent reliability.

The attached description (Attachment I) of the design and reliability of HFA and HGA relays was provided by General Electric (manufacturer of the relays) in response to recent questions regarding the reliability of these relays. The identification of 1 HFA failure and 0 HGA failures, as described

in the VY-specific documentation review, verifies the close correlation between the reliability of relays utilized at VY, and the generic published reliability (Attachment I) of these relays. It is significant to note that the single HFA relay failure was due to the old-style HFA coil and not due to the newer Century Series HFA coil presently installed in VY safety systems.

Other BWRs

As discussed during the March 15, 1988 presentation, VY would like to reiterate that the utilization of similar relays to those used at VY by the majority of other BWRs provides a large population of equipment (several hundred relays per plant) upon which reliability conclusions can be drawn. Twenty-three of thirty other BWRs perform the Logic System Functional tests during refueling intervals or every 18 months. Furthermore, equipment at the older plants has been in service longer than the relays at VY with no decrease in reliability due to any aging effects. Past and continuing experience with this equipment provides assurance that the equipment is indeed reliable over long periods of operation, and is capable of providing reliable service over its 40-year design life.

Vermont Yankee Commitment to Reliable and Safe Operation

The reliability of relays or of any of the equipment utilized at VY is strengthened by VY's attention to maintenance as an important contributor to safe operation. This dedication was evidenced by VY's program, implemented over the years 1983 through 1986, to replace safety class HFA relay coils when the industry identified a generic problem with these coils back in 1982. The application and use of industry generic information regarding equipment problems has often precluded or eliminated the same problem from occurring at a specific plant. The real reliability of any component, therefore, should take into account that anticipatory and preventative maintenance programs are well organized and share a huge "database" of industry experience for just about any component used in a nuclear power plant. In addition, the numerous detailed maintenance, operation, and testing procedures existing at VY ensure that commitments to reliable and safe operation are continuously implemented.

Conclusion

Based upon the above discussions and the results of all subject reviews, it is concluded that the relays utilized at VY have proven, on the basis of active service and vendor testing, to be highly reliable components whose reliability is insensitive to testing frequency.

TABLE 1

VERMONT YANKEE SPECIFIC RELAY FAILURES - 1983 TO 1987

Type Of Relay	Normal Condition	Type Of Failure	How Was Failure Discovered?	Would Logic Testing Have Detected Failure?	How Was Failure Documented?	Year	Comments	Failure No.
GE CR120	DE-EN	Timer Malfunction, MR Required	Logic Functional Surveillance Test	Yes	1) Past Logic Surveillance Test Result 2) LER 83-17/3L	1983	10A-K45A TDPU LER has INCOR ID	1
AGASTAT Model 2412	DE-EN	Timer Malfunction - Timer Not Adjustable, MR Required	Logic Functional Surveillance Test	Yes	1) Past Logic Surveillance Test Result 2) PRO-38	1983	13A-K42 Time Delay Setpoint out of Administration Limits. Not out of T.S.	2
AGASTAT Model 2412	DE-EN	Timer Malfunction - MR Required	Logic Functional Surveillance Test	Yes	1) Past Logic Surveillance Test Result	1984	13A-K42 Time Delay	3
AGASTAT Model 2412	DE-EN	Timer Out Of Tolerance - Required Adjustment	Logic Functional Surveillance Test	Yes	1) Past Logic Surveillance Test Result	1985	13A-K42 Time Delay Not Considered to be a Failure	-
GE CR120	Energized	Coil (Control Relay in the RPS MG Set)	1/2 SCRAM Received	Not Applicable RPS	1) LER 87-01	1987	Proposed Change in Testing is Not Applicable to This System	4
GE HFA	Energized	Coil, Relay Replaced	1/2 ISOL Received	Yes	1) PRO-4 (1983)	1983	Fail Safe Old Style Coil 16A-K3C	5

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VERMONT YANKEE SPECIFIC RELAY FAILURES - 1983 TO 1987

Type Of Relay	Normal Condition	Type Of Failure	How Was Failure Discovered?	Would Logic Testing Have Detected Failure?	How Was Failure Documented?	Year	Comments	Failure No.
AGASTAT Model E7014	DE-EN	Timer Malfunction, Timing Mechanism Failed	RCIC STM Line High Flow Func./Calib. OP-4364	Yes	1) PRO-56 (1983)	1983	13A-K7 TD	6
GE CR120	Energized	Not Specified, MR Required	During Ground Check	No, This Relay is Exempt From Logic Testing per Vermont Yankee Technical Specification	1) PRO-18 (1985)	1985	16A-K16, This Failure Would Have Been Detected During Once/Operating Cycle Testing	7
AGASTAT ETR	DE-EN	Timer Malfunction, Timer Reset	Logic Functional Surveillance Test	Yes	1) PRO-87-46 2) Past Logic Surveillance Test Result	1987	10A-K50A Timer Out Of T.S. Limit	8

New GE CENTURY Series Auxiliary Relays Types HFA, HGA, and HMA

GENERAL ELECTRIC

ATTACHMENT I

GEZ-6847

NEW GE CENTURY SERIES AUXILIARY RELAYS TYPES HFA, HGA and HMA

General Electric auxiliary relays such as HFA, HGA and HMA types, have a fine service record with very few failures. The service life of these rugged relays has been in the order of 30 to 40 years at 20°C average temperature, even when continuously energized at rated voltage. With this design, the elapsed time to first failure (that is, the time when 1% of all such relays have failed) is expected to be 10 to 12 years. Service experience of continuously energized HFA relays with ac coils has confirmed that expected life.

However, for nuclear stations, the Nuclear Regulatory Commission (NRC) is challenging the industry to design a cew criteria—not 40-year life, but 40 years with less than 1% failure. This is roughly four times longer than the present design which has an expected life of 10-12 years to 1% failure. Thus, 40-year life with less than 1% failure became the objective for a new GE auxiliary relay coil design.

The new design involves a change in the entire insulation structure.

- Relays with ac coils are the greatest challenge. These relays contain a shading ring on the pole piece to prevent chatter. Eddy currents flowing in the shading ring create localized heating. When continuously energized, the area of the coil spool near the shading ring runs even hotter than coil temperature rise would suggest. For this reason, the spool material is the finest high temperature polymer that could be found to obtain long-term strength at elevated temperatures. Under accelerated life testing, it did not crack or exhibit brittleness.

- The wire insulation has been changing to polyamide-imide film. Here the requirements were to retain insulation integrity and mechanical strength at continuous elevated temperatures, and also to be non-hydroscopic and fungus resistant.

- These polyamide-imide insulated coils, wound on high-temperature spools, are pre-baked to drive off all volatile materials, vacuum-pressure impregnated with a solventless varnish, and then post-baked. The impregnation material is also non-hydroscopic and has temperature expansion coefficients compatible with the spool and with the wire, so that stresses do not develop under temperature cycling.

Accelerated life tests have been completed on these new coils—tests run at elevated temperatures and maximum voltage. Using Arrhenius plots,* the new designs have not only met, but have exceeded, the design objective. The new coils have a life of 40 years to 1% failure not just at 20°C but at 55°C . . . that is 124°C continuously. This predicted life is not just at rated voltage, but at 110% rated voltage. At nominal conditions (that is at an ambient temperature averaging 20°C year round, day to night, winter to summer) when energized continuously at 100% rated voltage, we can expect 100 years—that's right—100 years average life even for ac coils!

The basic differences in the CENTURY auxiliary relays are as follows:

- Spool - High thermal strength polymer.
- Wire insulation - Polyamide-imide wire coating (180°C rating) Tefzel insulation where required, such as leads.
- Encapsulation - Polybutadiene solventless impregnant.
- Model No. - New but easy to determine. Simply add 100 to the old relay model number. Thus, HFA51A becomes HFA151A and HGA11J becomes HGA111J.
- Nameplate - Green, for easy visual differentiation from standard life relays.

Retrofit kits are now available for all prior design relays. All auxiliary relays now in service can be upgraded to the design life of the CENTURY series. . . 100-year average life under nominal conditions.

If GE Type HFA relays are now installed, just replace the coil, magnet assembly and nameplate with a CENTURY design modification kit.

If an HGA relay is now installed, just replace the coil and nameplate. The entire relay need not be replaced.

In the case of the Type HMA relay, it is recommended that the entire relay be replaced with a CENTURY series HMA, since this relay cannot be readily disassembled.

In all cases, new relays or retrofit, the green nameplate will serve as a reminder that this relay is a GE CENTURY series auxiliary relay.

* An established method for translating accelerated life tests at elevated temperature to service-life predictions.

General Electric Company
Power Systems Management
Philadelphia, PA 19142

December 16, 1977