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*R. B...*

Docket No. 50-298

SEP 27 1976

Nebraska Public Power District  
ATTN: Mr. J. H. Pilant, Director  
Licensing and Quality Assurance  
Post Office Box 499  
Columbus, Nebraska 68601

Gentlemen:

In response to your letter dated August 20, 1976, the Commission has issued the enclosed Amendment No. 28 to Facility Operating License No. DPR-46 for Cooper Nuclear Station.

The amendment adds, to the Appendix A Technical Specifications, a temporary restriction concerning machining alternate flow path holes in irradiated fuel bundle lower tie plates by means of the Electrical-Discharge Machining technique.

Copies of the related Safety Evaluation Report and the Notice of Issuance also are enclosed.

Sincerely,

Original signed by  
Dennis L. Ziemann

Dennis L. Ziemann, Chief  
Operating Reactors Branch #2  
Division of Operating Reactors

- Enclosures: *2*
1. Amendment No. 28 to License No. DPR-46
  2. Safety Evaluation Report
  3. Notice

cc w/enclosures:  
See next page

*The licensee was notified by phone of the approval of this amendment on Sept 27, 1976 at 5:20 pm. Ziemann contact: Jay Pilant  
Michael H Fletcher, ORB2*

OFFICE →	OR:ORB #2	OR:ORB #2 <i>MH</i>	OELD <i>DL</i>	OR:ORB #2	OR:RSB/OT
SURNAME →	RMDiggs <i>cp</i>	MFletcher <i>pro</i>	D SWANSON	DLZiemann	RBaer <i>RB</i>
DATE →	9/17/76	9/13/76	9/12/76	9/17/76	9/17/76

Nebraska Public Power District

- 2 -

September 27, 1976

cc w/enclosures:

Gene Watson, Attorney  
Barlow, Watson & Johnson  
P. O. Box 81686  
Lincoln, Nebraska 68501

Mr. Arthur G. Gehr, Attorney  
Snell & Wilmer  
400 Security Building  
Phoenix, Arizona 85004

Auburn Public Library  
118 - 15th Street  
Auburn, Nebraska 68305

cc w/enclosures and cy of  
NPPD filing dtd. 8/20/76:  
Mr. D. Drain, Director  
Department of Environmental Control  
Executive Building, Second Floor  
Lincoln, Nebraska 68509



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

NEBRASKA PUBLIC POWER DISTRICT

DOCKET NO. 50-298

COOPER NUCLEAR STATION

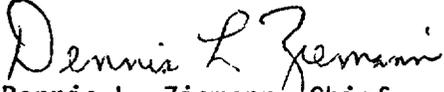
AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 28  
License No. DPR-46

1. The Nuclear Regulatory Commission (the Commission) has found that:
  - A. The application for amendment by Nebraska Public Power District (the licensee) dated August 20, 1976, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;
  - B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;
  - C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;
  - D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and
  - E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment.
3. This license amendment is effective as of the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

  
Dennis L. Ziemann, Chief  
Operating Reactors Branch #2  
Division of Operating Reactors

Attachment:  
Changes to the Technical  
Specifications

Date of Issuance: September 27, 1976

ATTACHMENT TO LICENSE AMENDMENT NO. 28

FACILITY OPERATING LICENSE NO. DPR-46

DOCKET NO. 50-298

Replace existing page iv of the Appendix A portion of the Technical Specifications with the attached revised page bearing the same numeral. The changed area on the revised page is reflected by a marginal line.

## TEMPORARY RESTRICTIONS

1. When the results of the FitzPatrick hot (up to full power) vibration tests are available, they will be evaluated and compared with the results for CNS. In the event that the FitzPatrick tests, or results of startup programs and power operation of Browns Ferry Unit 1, indicate potential problems in areas which could not have been detected in CNS due to differences in instrumentation, appropriate corrective action will be required.
2. Drilling of alternate flow path holes in the lower tie plates of unirradiated fuel bundles at the CNS site is permitted provided the procedures of Section 3 of General Electric Document NEDE 21156 are followed and GE personnel or personnel properly trained by the General Electric Company, perform the drilling.
3. Machining of alternate flow path holes in the lower tie plates of irradiated fuel bundles by means of electrical-discharge machining at the CNS site is permitted provided that the procedures described in letters from G. C. Ross, GE, to D. G. Eisenhut, NRC, dated April 1, and April 23, 1976 are followed and GE personnel, or personnel properly trained by the General Electric Company, perform the machining.
4. The above restrictions apply until removed by written instructions of the NRC staff.



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 28 TO LICENSE NO. DPR-46

NEBRASKA PUBLIC POWER DISTRICT

COOPER NUCLEAR STATION

DOCKET NO. 50-298

INTRODUCTION

In late 1974, a foreign boiling water reactor observed a change in the characteristics of the readings from certain of the in-core instruments. Subsequent examination of the fuel bundle channel boxes in the foreign reactor revealed significant wear on the corners of channel boxes adjacent to instrument and source tubes. This wear had led to cracking and holes in the channel boxes adjacent to the instrument that had displayed the anomalous readings. The General Electric Company notified the NRC immediately of a possible similar problem in domestic boiling water reactor plants. The presence of cracks or holes in a channel box is of concern since it would allow part of the cooling water that normally flows through the fuel bundles to flow out of the cracks or holes and bypass the fuel rods. Such a change in flow pattern would decrease the safety margins for the thermal performance of the fuel. These reduced margins could lead to overheating and damage to the fuel in the event of some anticipated operating transients or some postulated accidents. Significant wear and cracking of the channel boxes would also affect their mechanical strength for transients and accidents.

Investigation of the problem revealed that primary coolant crossflow in the bypass region of the core had induced the vibration of in-core instrument and source tubes. The instrument and source tubes were impacting the channel box corners and causing the formation of cracks and holes in the channel boxes. To eliminate significant instrument and source tube vibration, General Electric (GE) has recommended plugging of the one inch diameter bypass holes in the lower core plate and drilling two small holes in each fuel bundle lower tie plate to provide an alternate bypass flow path. This modification was described in a GE report to the NRC, NEDE 21156, "Supplemental Information for Plant Modification to Eliminate Significant In-Core Vibration," (Proprietary) of January 1976.

At present, Cooper Nuclear Station (CNS) has the one inch bypass holes in the lower core support plate plugged. This action was approved by the Commission's "Order for Modification of License" (40 F.R. 48554 October 16, 1975). Amendment No. 30 to the CNS Facility Operating License, issued June 11, 1976, approved the drilling of alternate bypass flow holes in the unirradiated fuel bundles presently stored at the CNS site. By letter dated August 20, 1976, Nebraska Public Power District (NPPD) requested a license amendment to permit machining of alternate bypass flow holes in the irradiated fuel bundles at CNS, with the exception of from 8 to 16 Type 1 bundles, by means of the Electrical-Discharge Machining (EDM) technique. This safety evaluation is concerned only with the machining of irradiated fuel bundles at CNS. The operation of a reactor core containing fuel bundles with alternate flow paths in the lower tie plates will be evaluated at a future date.

#### DISCUSSION/EVALUATION

The EDM process for machining alternate bypass flow holes in fuel bundle lower tie plates is described in two letters from G. C. Ross, GE, to D. G. Eisenhut, NRC, dated April 1 and 23, 1976, Subject: "Electrical-Discharge Machining of Lower Tie Plates." EDM is a method of removing metal by electrical discharge between an electrode and a work piece in a dielectric bath. The dielectric in this case is the demineralized water in the spent fuel pool, where the machining will be performed, and the demineralized water from within the annular electrode. The surface finish of the hole resulting from EDM is characterized by roughness in the resolidified zone with some carbon diffused into the base metal underlying this zone. To assure proper bypass hole dimensions are maintained during the use of EDM, the process will be periodically qualified by machining "dummy" lower tie plates with each EDM electrode and taking measurements on these "dummy" tie plates. GE has analyzed the efficiency of the debris removal procedures for EDM. They have determined, for the worst case, that much less than one weight percent of the total debris generated will be uniformly distributed over the outer surface of the fuel channel. Also, the EDM process requires a visual inspection of each irradiated fuel bundle both inside and out to provide reasonable assurance that no anomalous damage has occurred. In order to shield the personnel performing the machining from the high levels of radiation emanating from the irradiated fuel bundles, the EDM equipment is designed for remote operation while submerged under approximately 25 feet of water in the spent fuel pool. In addition, the irradiated fuel bundles would be handled and machined using health physics procedures identical to the previously approved procedures used in handling irradiated fuel during a core refueling. GE has demonstrated the performance of the EDM process during an extensive operator training and qualification program in which over one hundred holes were successfully machined in irradiated fuel bundle lower tie plates.

The EDM process has been evaluated previously and found acceptable by the NRC staff in a Safety Evaluation dated May 1976 (attached as Appendix 1). The conclusions of this evaluation are summarized below:

1. It was concluded that stress levels in the lower tie plates, including residual tensile stresses created by EDM, were still an order of magnitude lower than the allowable stress levels.
2. Although EDM may reduce the fatigue life of the electrical-discharge machined surface, it was concluded that no significant fatigue loadings are expected on the lower tie plate, especially at the location of the two bypass flow holes.
3. Even though the EDM process results in the diffusion of a small amount of carbon into the base metal underlying the resolidified surface, the corrosion resistance of the surface is not significantly impaired and the corrosion resistance of the base metal underlying the carbon diffusion zone remains unaffected.
4. The uniform distribution of one weight percent of the total debris generated in the EDM process over the outer surface of the fuel channel would result in negligible effects on channel performance.
5. It was also concluded that the flow through EDM produced holes would not be significantly different from the flow through the previously approved drilled holes, and the technique is therefore acceptable from hydraulic considerations.

In its August 20, 1976 request for a license amendment, NPPD proposed to machine bypass flow holes in irradiated bundle lower tie plates by means of the EDM process as reviewed and accepted by the NRC staff in its May 1976 Safety Evaluation Report.

Based on the above, the NRC staff has concluded that machining alternate bypass flow holes in irradiated fuel bundles at CNS using the EDM process performed by GE personnel, or personnel properly trained by GE, is acceptable.

ENVIRONMENTAL CONSIDERATION

We have determined that the amendment does not authorize a change in effluent types or total amounts nor an increase in power level and will not result in any significant environmental impact. Having made this determination, we have further concluded that the amendment involves an action which is insignificant from the standpoint of environmental impact and, pursuant to 10 CFR §51.5(d)(4), that an environmental impact statement or negative declaration and environmental impact appraisal need not be prepared in connection with the issuance of this amendment.

CONCLUSION

We have concluded, based on the considerations discussed above, that: (1) because the change does not involve a significant increase in the probability or consequences of accidents previously considered and does not involve a significant decrease in a safety margin, the change does not involve a significant hazards consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Attachment:  
Appendix 1 - Safety Evaluation  
dated May 1976

Date: September 27, 1976

APPENDIX 1

Safety Evaluation Report on Electrical-Discharge  
Machining of Lower Tie Plates  
of Irradiated BWR Fuel Assemblies

BY

Office of Nuclear Reactor Regulation  
U. S. Nuclear Regulatory Commission

May 1976

## 1.0 Introduction

The General Electric Co. has developed a modification to eliminate instrument tube impacting on the channel box corners that does not result in a restriction on power generation.<sup>(1,2)</sup> The modification consists of both plugging the 1 inch bypass holes and the addition of an alternate flow path in the form of two holes in the lower tie plate of each fuel assembly. The two holes in the tie plate were sized to provide the bypass flow essential for removing any operational restrictions due to channel box corner wear.

The staff has reviewed the GE modification and issued a Safety Evaluation Report on March 2, 1976.<sup>(3)</sup> The key elements of the review were the results of site inspections on channel boxes, the results of out-reactor simulation testing, and the analyses of the effects on mechanical, thermal-hydraulic and nuclear considerations.

Included within the above Safety Evaluation Report by the staff was approval of implementing the modification by drilling the alternate flow path holes in the lower tie plate of irradiated assemblies. The drilling is remote (under 25 feet of water) and was demonstrated in out-reactor test facilities at San Jose. However, attempts to apply the remote drilling at Browns Ferry Units 1 & 2 were less than satisfactory.

Subsequently, GE has submitted to the staff a request to perform the drilling by Electrical-Discharge Machining (EDM). (4,5) The staff has reviewed this alternate technique. This Safety Evaluation Report summarizes the review and discusses the basis for our conclusions.

## 2.0 The EDM Process

Electrical-Discharge Machining (EDM) was approved by the staff as a method to remove broken drill bits from the lower tie plates.<sup>(3)</sup> However, the review of the EDM process as a primary method for drilling the alternate flow path holes is summarized herein.

Electrical-Discharge Machining is a method of metal removal achieved by electrical discharge between an electrode and a work piece in a dielectric bath. The dielectric in this case is the demineralized water both from the spent fuel pool and from within the annular electrode. The electrode-to-work-piece gap is held at about .001 inches throughout the process. The governing process parameters include amperage, voltage and discharge frequency.

The resultant surface finish depends upon the process parameters which also determine the rate of metal removal. The process parameters (voltage, current and frequency) used by the applicant in qualifying the process are atypical of those for EDM surfaces subject to fatigue loads. However, the holes have been sized to account for the surface roughness (Section 3.0) and the lower tie plate is not subject to fatigue loads (Section 4.0).

General Electric has committed to continually qualify the process during its application by EDM dummy tie plates with each electrode and subsequently making dimensional measurements on these dummy tie plates. Additionally, each irradiated fuel bundle will

be visually examined both inside and outside. This post-EDM examination will provide reasonable assurance that anomalous damage has not occurred.

The function of the drilled holes is to provide an alternate flow path only. Thus the rough, abrasive, resolidified surface yielded by the process parameters will be innocuous since wear is not a functional requirement.

The EDM process results in the diffusion of carbon into the base metal underlying the resolidified surface. The corrosion resistance of such surfaces is not significantly impaired and the corrosion resistance of the underlying base metal remains unaffected. Even so, the reactor coolant water is a non-aggressive corrosive environment to the stainless steel lower tie plate.

The General Electric Co. has analyzed the efficiency of their debris removal procedures for the EDM process. They have provided acceptable assurance that the debris generated from EDM will be captured. Their analysis indicates for the worst case that much less than one weight percent of the total debris generated (less than .001 cubic inches) will be uniformly distributed over the outer surface of the fuel channel. The effect of this small quantity on the channel performance will be negligible.

### 3.0 Hydraulic Considerations

The reproducibility of the size, shape, and surface roughness of lower tie plate holes produced by the EDM technique was reviewed to determine the technique's ability to produce holes that will provide the required (design) bypass flow. It was concluded, for the reasons detailed below, that the flow through EDM produced holes will not be significantly different from flow through the previously approved drilled holes, and the technique is therefore acceptable from hydraulic considerations.

#### 3.1 Surface Roughness and Chamfer Affects on Hydraulic Loss Coefficient

Wall friction losses are calculated to account for less than 4% of total hole flow losses. Consequently, since even a doubling of surface roughness (from 200 to 400 microinches) results in only a 0.5% change in loss coefficient which would permit a negligible 0.012% change in flow, it is not believed that any credible difference in surface roughness in the EDM holes could significantly affect flow.

No entrance or exit ridges were observed on the test EDM holes, and entrance and exit radii were very sharp with insignificant variation (0.6 to 2.0 mils). Therefore no significant flow variation would be expected from variability of these dimensions.

#### 3.2 Effects of Holes Size

For the last 100 test EDM holes, inlet and outlet diameter standard deviations ( $\sigma$ ) of only 1.85 and 1.56 mils, respectively, were measured. For a  $2\sigma$  change in inlet and outlet diameter, the

predicted flow change is only 2.5%.

### 3.3 Overall Effect on Flow (Hydraulic Acceptability)

When the worst combination of the above effects is assumed, a flow variability through any individual hole of less than 3% from the average flow through the nominal hole might be expected. Even if all EDM holes were at the 3% high (or low) value as compared to the predicted flow through holes, when other sources of bypass flow are considered it is shown that the total bypass flow percentage (nominally 10 to 12% of total core flow) would change by only about 0.12%. This is well within the range of allowable uncertainty in bypass flow. Consequently, it is concluded that the EDM technique is acceptable from hydraulic considerations.

#### 4.0 Mechanical Considerations

A complete stress analysis for the effects of the holes in the lower tie plate was previously completed including the stress concentrations for normal, abnormal and postulated accident loads. The stress levels were determined to be an order of magnitude less than the allowable stress levels.<sup>(1)</sup> The staff has reviewed this stress analysis and found it acceptable<sup>(3)</sup>.

#### 4.1 Stress Levels

Additional residual tensile stresses may occur on the surface created by the EDM process. The reported thickness of this surface layer is small (about 0.001 inch). The stress level in the lower tie plate remains an order of magnitude below the allowable stress level as determined by staff calculations. Therefore, our previous conclusions regarding the acceptability of the stress levels does not change for the EDM of holes in the lower tie plate.

#### 4.2 Fatigue Loads

As stated in section 2.0, the EDM surface layer fatigue life can be reduced. However, no significant fatigue loadings are expected on the lower tie plate and especially at the location of the two alternate flow holes. Neither mechanically nor thermally induced loads during plant operations are anticipated to reduce the essential safety margins in the tie plate mechanical design.

## 5.0 Conclusions

The review summarized above included both the EDM process and the resultant product along with the effects due to loads, flow restrictions and corrosion. This review forms the basis for our conclusion that the EDM process on irradiated lower tie plates as described in references 4 and 5 is acceptable as an alternative implementation of part of a modification to eliminate significant impacting of instrument tubes on channel box corners.

References

1. "Peach Bottom Atomic Power Station Units 2 and 3: Safety Analysis Report for Plant Modifications to Eliminate Significant Incore Vibration", NEDC-20994, September 1975, General Electric Co. Proprietary.
2. "Supplemental Information for Plant Modification to Eliminate Significant Incore Vibration", NEDE-21156, January 1976, General Electric Co. Proprietary.
3. Letter from D. G. Eisenhut, OT, to K. Goller, OR, dated March 2, 1976, Subject: "Modification to Eliminate Significant Incore Vibration".
4. Letter from G. C. Ross, GE, to D. G. Eisenhut, NRC, dated April 1, 1976, Subject: "Electrical Discharge Machining of Lower Tie Plates".
5. Letter from G. C. Ross, GE, to D. G. Eisenhut, NRC, dated April 23, 1976, Subject: "Electrical Discharge Machining of Lower Tie Plates".

UNITED STATES NUCLEAR REGULATORY COMMISSION

DOCKET NO. 50-298

NEBRASKA PUBLIC POWER DISTRICT

NOTICE OF ISSUANCE OF AMENDMENT TO FACILITY  
OPERATING LICENSE

The U. S. Nuclear Regulatory Commission (the Commission) has issued Amendment No. 28 to Facility Operating License No. DPR-46, issued to Nebraska Public Power District (the licensee), which revised Technical Specifications for operation of the Cooper Nuclear Station (the facility) located in Nemaha County, Nebraska. The amendment is effective as of its date of issuance.

The amendment revised temporary restrictions in the Technical Specifications for the facility to permit, under certain conditions, the machining of alternate flow path holes in irradiated fuel bundle lower tie plates at the Cooper Nuclear Station site by means of electrical-discharge machining.

The application for the amendment complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations. The Commission has made appropriate findings as required by the Act and the Commission's rules and regulations in 10 CFR Chapter I, which are set forth in the license amendment. Prior public notice of this amendment was not required since the amendment does not involve a significant hazards consideration.

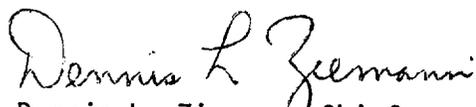
The Commission has determined that the issuance of this amendment will not result in any significant environmental impact and that pursuant to 10 CFR 51.5(d)(4) an environmental impact statement or negative declaration and environmental impact appraisal need not be prepared in connection with issuance of this amendment.

For further details with respect to this action, see (1) the application for amendment dated August 20, 1976, (2) Amendment No. 28 to License No. DPR-46, and (3) the Commission's related Safety Evaluation. All of these items are available for public inspection at the Commission's Public Document Room, 1717 H Street, N. W., Washington, D. C. and at the Auburn Public Library, 118 - 15th Street, Auburn, Nebraska 68305

A copy of items (2) and (3) may be obtained upon request addressed to the U. S. Nuclear Regulatory Commission, Washington, D. C. 20555, Attention: Director, Division of Operating Reactors.

Dated at Bethesda, Maryland, this 27th day of September, 1976.

FOR THE NUCLEAR REGULATORY COMMISSION

  
Dennis L. Ziemann, Chief  
Operating Reactors Branch #2  
Division of Operating Reactors

Treby has seen  
per Linda in OELD Mail  
Room  
RD  
9/22

September 21, 1976

Note to: ~~Stuart Treby~~

RE: COOPER TECH SPEC CHANGE

On June 11, 1976, the NRC issued a tech spec change for the Cooper OL approving the drilling of alternate bypass flow holes in unirradiated fuel bundles being stored for loading in the facility. The purpose of the change is to reduce vibration of in-core instrument and source tubes caused by coolant crossflow. This vibration has caused the formation of cracks and holes in channel boxes in some foreign BWRs. GE has proposed to drill these holes in all the domestic BWRs that it has built.

I concurred in the June 11 tech spec change conditioned on the full review of the channel box problem by the Staff, including pre-noticing, prior to operation of the facility with the drilled fuel.\* The licensee has shut down Cooper for refueling, and now proposes to drill the holes in the irradiated fuel. The safety considerations (other than occupational exposure) are basically the same as exist with drilling of the unirradiated fuel, and the safety evaluation appears to adequately consider the proposal, except for health physics considerations.

However, Joe Scinto indicated that drilling of irradiated fuel has much greater potential consequences of exposing workers to radiation than does drilling of unirradiated fuel. The safety evaluation is devoid of any description of the health physics aspects of the drilling operation. Without such an analysis there is no assurance that the operation will be in compliance with 10 CFR Part 20 with respect to occupational exposures. I therefore withhold my concurrence, and recommend that a section be inserted in the evaluation which analyzes the method of protecting drilling workmen and evaluates the health physics aspects of the proposed activities.

DA

Daniel T. Swanson

\* Although the upper management of ELD concurred in the operation of Vermont Yankee with drilled fuel without pre-noticing the channel box problem, I still maintain that the matter is sufficiently serious to pre-notice. Joe Scinto agree with this position.