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Docket No. 50-298

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

Gentlemen:

Enclosed is a signed original of the "Order for Modification of License" issued by the Commission for the Cooper Nuclear Station. The Order adds a provision to License No. DPR-46 stating that you are authorized to install bypass hole plugs in the lower core plate and that the facility shall not operate subsequent to the installation of bypass hole plugs without authorization by the Office of Nuclear Reactor Regulation. A copy of the Order is being filed with the Office of the Federal Register for publication. Copies of our related Safety Evaluation and the Evaluations dated June 18, 1975, on Duane Arnold and August 15, 1975, on Vermont Yankee also are enclosed.

Sincerely,
Original Signed by:
Dennis L. Ziemann

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

Enclosures:
1. Order for Modification of License
2. Safety Evaluation of Mechanical Plugs to be Inserted into the Bypass Holes of the Cooper Nuclear Station
3. Safety Evaluation of Mechanical Plugs to be Inserted into the Bypass Holes of the Duane Arnold Energy Center Reactor
4. Safety Evaluation of Mechanical Plugs to be Inserted into the Bypass Holes of the Vermont Yankee Nuclear Power Station

I called NPPD & IGE Region IV. mornings of 10/9/75 R Silver

RL:ORB #2 T. Engelhardt KRG

OFFICE	RDSilver:ah DLZiemann	OELD	RL:AD/ORs	RL:A/DIR	NRR:E/DIR	NRR:DIR
SURNAME			-KRGoller	RSBoyd	EGCase	BCRusche
DATE	10/07/75	10/ /75	10/7/75	10/ /75	10/ /75	10/ /75

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of	)	
	)	
NEBRASKA PUBLIC POWER DISTRICT	)	Docket No. 50-298
	)	
(COOPER NUCLEAR STATION)	)	

ORDER FOR MODIFICATION OF LICENSE

I.

Nebraska Public Power District (the licensee) is the holder of Facility Operating License No. DPR-46 which authorizes operation of the Cooper Nuclear Station (the facility) at steady-state reactor core power levels not in excess of 2381 megawatts thermal (rated power). The facility is a boiling water reactor (BWR) located near Brownville, Nemaha County, Nebraska.

II.

1. On July 22, 1975, the Nuclear Regulatory Commission (the Commission) issued an "Order for Modification of License" (40 Fed. Reg. 31837, July 29, 1975) which confirmed a plan for limited additional operation of the facility. As detailed in the Order, the facility's channel box wear, as indicated by the noise-to-signal ratio recorded by the traversing incore probe (TIP), had exceeded the remedial action threshold. The remedial plan confirmed by the Order limited operation of the facility at not more than 40% of rated core flow and with a maximum fuel bundle power of 3.20 MWt. In addition, the Order permitted operation up to full flow and power for a brief period of time as necessary to collect flow vibration and water quality data. The Order further stipulated that the

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licensee was to shutdown the facility following approximately 45 equivalent full flow days from April 26, 1975 unless within that period certain specified tests have been completed which demonstrated the efficacy of the 40% flow limit.

2. On August 1, 1975, the Commission issued an "Order for Modification of License" (40 Fed. Reg. 33739, August 11, 1975) which clarified the intent of the July 22, 1975 Order to explicitly allow continued operation for the balance of a period of 50 effective full flow days prior to demonstrating the efficacy of the 40% flow limit. The bases for this action were schedules for delivery of equipment needed for accelerometer tests and the desirability from a power demand standpoint to schedule the installation of the equipment during a weekend or other low load period. The Commission's staff, in its August 1, 1975 evaluation of the request, concluded that the recently obtained TIP traces did not show any accelerated channel box wear, and that operation of Cooper for the balance of a period of 50 effective full flow days prior to demonstrating the efficacy of the 40% flow limit was acceptable since no appreciable additional wear would be incurred.

3. By letter dated September 11, 1975, the licensee proposed a plan, previously discussed with the NRC staff, setting forth a course of remedial action, which would allow operation with flow rates above 40 percent of rated flow and maximum bundle power above 3.20 MWt. The plan would involve shutdown of the reactor and appropriate replacement of worn channel boxes and plugging of the core support plate bypass holes.

4. By its letter dated September 11, 1975[1/], the licensee provided details (by reference to previous staff evaluations for the Vermont Yankee and Duane Arnold plants) relating to the installation of core bypass flow plugs in the lower core plate and supplied analyses to demonstrate the adequacy of such plugs to minimize future channel box wear and the adequacy of the procedures for plug installation.

5. The installation of the core bypass flow plugs in the lower core plate is designed to reduce the instrument tube - channel box interaction that produced the unacceptable wear. The referenced reports in the licensee's letter of September 11, 1975, lists a total of 75 channels that were inspected during normal refueling outages in seven plants that have instrument thimbles similar to those in the Cooper reactor, but that do not have flow bypass holes. The bypass flow for these plants enters through clearances in the fuel assembly and fittings which are similar to the proposed Cooper configuration with plugged bypass flow holes. For this configuration, no significant wear was observed at the corners of the channel boxes adjacent to the instrument thimbles.

1/ Copies of (1) the September 11, 1975 filing by the licensee, and (2) the NRC staff Safety Evaluation of Mechanical Plugs to be Inserted in the Cooper Nuclear Station and the documents referenced therein, are available for public inspection in the Commission's Public Document Room, 1717 H Street, N.W., Washington, D. C., and are being placed in the Auburn Public Library, 1118 -15th Street, Auburn, Nebraska 68305.

6. Plugs identical to those proposed for the Cooper reactor have previously been installed in the Vermont Yankee and Pilgrim reactors in 1973 and 1974, respectively, to eliminate the vibration of temporary control curtains that caused channel box wear in those reactors. They have also been installed in the Duane Arnold and Vermont Yankee reactors to mitigate channel box wear. The plugs in the Vermont Yankee reactor installed in 1973 were removed at the time that the temporary curtains were removed after ten months of successful service. In addition, the General Electric Company has conducted tests to demonstrate the adequacy of the plug design. These tests included full flow mockup tests which demonstrated negligible leakage flow through the plugged holes. The NRC staff has reviewed the design, the testing, and the previous experience with the proposed plugs in the Vermont Yankee and Pilgrim reactors, and in its concurrently issued Safety Evaluation of Mechanical Plugs to be Inserted in the Cooper Nuclear Station, the staff concluded that the mechanical design of the proposed bypass flow plugs is acceptable and that the plugs will reduce the vibration of the instrument thimbles caused by flow through the bypass holes and that installation of the plugs should be authorized. Subsequent operation of the facility with the plugs installed is under review.

III.

Accordingly, pursuant to the Atomic Energy Act of 1954, as amended, and the Commission's Rules and Regulations in 10 CFR Parts 2 and 50, IT IS ORDERED THAT Facility Operating License No. DPR-46 is hereby amended by substituting the following provisions for the provisions set out in Appendix A to the Commission's Order for Modification of License dated July 22, 1975, as amended August 1, 1975:

1. The licensee is authorized to install bypass hole plugs in the facility's lower core plate. The licensee shall not, without prior written approval of the Director, Office of Nuclear Reactor Regulation, return the facility to operation following the installation of the bypass hole plugs.

FOR THE NUCLEAR REGULATORY COMMISSION

Original signed by
Ben C. Rusche

Ben C. Rusche, Director
Office of Nuclear Reactor Regulation

Dated at Bethesda, Maryland,
this 24th day of October, 1975.

SAFETY EVALUATION OF MECHANICAL PLUGS TO BE INSERTED INTO THE BYPASS HOLES OF THE COOPER NUCLEAR POWER PLANT

This memorandum summarizes the NRC staff's evaluation of the mechanical adequacy of core plate bypass hole plugs for insertion into the Cooper reactor.

The licensee plans to use the same method and type of plug reviewed by the NRC staff for Vermont Yankee and for the Duane Arnold Energy Center Plant.(1)(2)

The plug consists of five basic parts, as shown in Figure 1. Identical plugs have previously been installed at Vermont Yankee, Pilgrim, and Duane Arnold. The body provides a means of guiding the device into the bypass flow holes as well as a shoulder to support the plug and form a seal against water flow. The shaft extends through the body. A knob is provided at the top of the shaft to provide a means of grabbing the plug during installation and extraction. At the bottom, the latch is attached to the shaft by a pin. The latch is free to rotate during installation. The spring acts against the body and shaft during normal operation to provide the force necessary to offset the pressure differential acting on the body.

During installation, the plug has its latch rotated 90 degrees from its installed position and withdrawn and locked in the body. The shaft is gripped by the installation tool, and the plug is inserted into the bypass flow holes. The body engages the rim of the hole. The shaft is pushed to its full extension, thus lowering and unlocking the latch below the underside of the core plate. The latch then rotates 90 degrees and bears on the bottom of the core plate. After insertion, the plug is pulled with about 30-pound force to test the placement.

The plug can be removed by gripping the top of the shaft with an extracting tool and applying a force of about 500 pounds. The latch's legs will be plastically deformed and the entire plug withdrawn. The plugs previously installed at Vermont Yankee were removed with no abnormalities or loose pieces reported. The force required for removal varied from 500 to 1300 pounds.

(1) Safety Evaluation of Mechanical Plugs to be Inserted into the Bypass Holes of the Duane Arnold Energy Center Reactor issued June 18, 1975.
(2) Safety Evaluation of Mechanical Plugs to be Inserted into the Bypass Holes of the Vermont Yankee Nuclear Power Plant issued August 15, 1975.

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based on a review of the design, the test rig, the installation methods and the previously successful operating experience at Vermont Yankee, Pilgrim, and Duane Arnold, we conclude that the plugs will not fail so as to result in loose parts in the core or result in unplugging of the bypass flow holes. Also, we conclude that the installed plugs will preclude unacceptable channel box damage for at least the proposed fuel cycle. Surveillance programs will be required to confirm the nature and extent of any residual tube excitation and resultant effect, if any, on core components.

Accordingly, we conclude that the installation of the plugs should be authorized. Operation with plugged bypass holes is still under review.

Date: OCT 0 8 1975

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SAFETY EVALUATION OF MECHANICAL PLUGS TO BE INSERTED INTO THE BYPASS HOLES OF THE DUANE ARNOLD ENERGY CENTER REACTOR

This memorandum summarizes the NRC staff's evaluation of the mechanical adequacy of coolant hole plugs for insertion into the Duane Arnold reactor.

The analyses of the plugs submitted for the staff review were based upon data and assessments by the reactor vendor, the General Electric Company.(1) General Electric presented to the NRC staff a summary of inspections on BWR-2s and BWR-3s (Table I). These older plants have instrument tubes similar to Duane Arnold, but no flow augmentation holes in the core support plate. The bypass flow for these plants enters through clearances in the assembly end fittings, which is similar to the proposed Duane Arnold configuration with plugged augmentation holes. Sixty-four channels (adjacent to instrument tubes and source tubes) were inspected during normal fuel outages in 5 plants. No significant channel wear was observed at the corners adjacent to the instrument tubes.

The conclusion from these data is that plugged augmentation holes in Duane Arnold will substantially reduce the instrument tube-channel interaction that resulted in excessive wear.

A correlation between BWR channel box wear and lower core plate bypass flow holes has led to the development of a mechanical plug to fill these holes (Figure 1).

The core plate plug consists of two stainless steel parts (body and shaft) which are connected by an Inconel spring. The shoulder of the body rests on the top of the core plate along the rim of a one-inch bypass hole and is pressed down by the spring. An equal and opposite force is applied on the shaft. A stainless steel latch is connected to the bottom of the shaft by means of a pin. This latch is free to rotate about the pin and latches the shaft to the core plate. The spring exerts a minimum load of 38 lbs on the body and latch and a maximum of 46 lbs (with the worst tolerance combination).

During installation the latch is in a position rotated 90 degrees from its installed position and is withdrawn into the body. The shaft is gripped by the installation tool and the plug is inserted into the bypass flow hole. First the body engages the rim of the hole and then the spring is compressed to push the shaft to its full extension.

The latch then comes out of the body and rotates 90 degrees by means of an eccentric weight with respect to the pin. When the installation tool is relaxed, the latch bears against the bottom of the core plate. After insertion, the plug is pulled with about 30 lbs force to check its placement. At the end of the next fuel cycle (after approximately

10 months of service), it is anticipated that the bypass flow hole plugs will be removed. Removal of a plug will be accomplished by applying about 500 lbs of force and deforming the latch plastically. More than 10 plugs were removed in tests performed at the GE test facility with consistent latch deformations without damaging other parts. Actual plugs were latched on a 2-inch plate with 1-inch diameter holes.

Analogous wear was previously observed on other core components in the Vermont Yankee and the Pilgrim reactors[2]. The source of the wear was also associated with the bypass flow holes. Plugs identical to those to be used in the Duane Arnold reactor were installed in both the Vermont Yankee and the Pilgrim reactors. The plugs in Vermont Yankee were removed during a refueling operation after 10 months of successful service. No abnormalities or loose pieces were reported. The force required for removal varied from 510 to 1300 pounds. Based on the successful experience at Pilgrim and Vermont Yankee, and on our assessment that flow through the bypass holes contributes significantly to the causes of channel box damage. We believe that the installed plugs will substantially reduce the instrument tube vibration due to flow through the bypass holes, sufficiently to preclude any unacceptable wear for at least the proposed fuel cycle.

Pressure differentials across the core plate during normal steady state operation and following a steam line break accident are expected to be on the order of 17 and 32 psi, respectively (somewhat plant-dependent). These loads together with the spring preload will produce yielding on the latch in bending but will be significantly below the 500 lbs of force necessary for removing the plug. The 1973 GE full scale flow mockup test shows that, with up to 40 psi differential pressure, there is negligible leakage flow through the plugged holes. No plug vibration was observed during the test and no apparent deformation on the latch was evident after the test. As previously mentioned, approximately 500 lbs were required to deform the latch plastically and remove it from the core plate. No fatigue and plastic strain ratcheting is expected since the plant power cycle during the anticipated 10 months service period will be minimal.

General Electric has obtained instrument tube vibration data with and without the agumentation flow holes plugged using their full scale test facility.[3] The tests, although not complete at this time, show a reduction in the amplitude of vibration when the holes are plugged.

Stainless steel and Inconel are compatible with other reactor internals and are not expected to introduce any unusual oxidation and stress corrosion problems. The flux level at the core plate elevation is estimated to be quite low and an insignificant reduction in ductility due to irradiation is anticipated. GE has performed creep tests with both Inconel springs and stainless steel latches and found that stress relaxation or creep deformation were insignificant. The tests were performed at 550°F.

Based on a review of the design, the test rig, the installation methods and primarily the previously successful operating experience at Vermont Yankee and Pilgrim, we conclude that the plugs will not fail so as to result in loose parts in the core or result in unplugging of the bypass flow holes. Also, we conclude that the installed plugs will preclude unacceptable channel box damage for at least the proposed fuel cycle. Surveillance programs will be required to confirm the nature and extent of any residual tube excitation and resultant effect, if any, on core components.

Accordingly, we conclude that the installation of the plugs should be authorized. The Licensees' safety analyses for operation with plugged bypass holes, submitted June 10, 1975, is still under review(4).

References

(1) Duane Arnold Energy Center, Channel Inspection Program and Core Bypass Flow Hole Plug Mechanical Design, June 5, 1975; submitted by letter from R. Lowenstein, attorney for IELPC, to B. Rusche, NRC, dated June 6, 1975.

(2) October 26, 1973, Safety Evaluation by the Directorate of Licensing USAEC Relating to Channel Box Wear in the Vermont Yankee Power Station and the Pilgrim Nuclear Power Station.

(3) "Summary of Regulatory Meeting on GE Channel Box Wear," memorandum from F. D. Coffman to D. F. Ross dated 5-22-75 (meeting held 5-14-75).

(4) Duane Arnold Energy Center "Safety Analyses with Bypass Flow Holes Plugged", June 9, 1975, submitted by letter from K. Shea, Esq., to B. Rusche, NRC, dated June 10, 1975.

TABLE I

SUMMARY OF CHANNELS INSPECTED

PLANTS WITHOUT BYPASS FLOW HOLES

		Channels Inspected					
BWR	Plant	Total	LPRM	IRM	SRM	Source	Exposure Range (GWD/t)
2	A	29	4	1	1	1	6-17
	B	41	4	7	2	8	10-19
	C	34	11	3	5	0	11-17
3	D	25	6	3	1	1	11-15
	E	14	5	1	0	0	12-13
Total Inspections		143	30	15	9	10	6-19

Results and Conclusions

- No channel wear of any kind observed on channels.
- Minor marks (no depth perceptible) sometimes observed where curtains were or had been. (Noted on channel sides).
- BWR-2 and BWR-3 plants which do not have lower core plate bypass holes do not exhibit in-core instrument or channel wear.

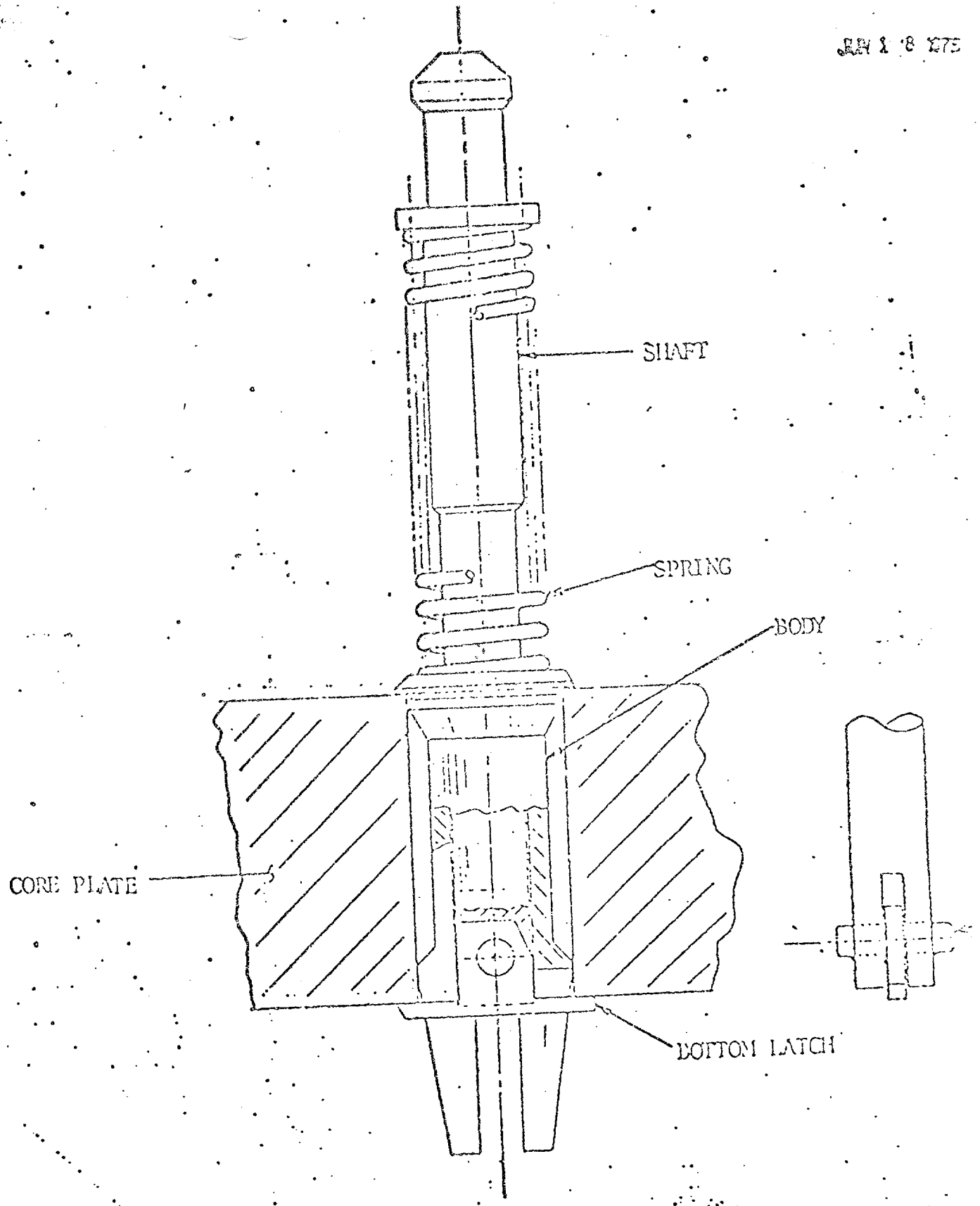

Figure 1 Plug Installed in Core Plate

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

SAFETY EVALUATION OF MECHANICAL PLUGS TO BE INSERTED INTO THE BYPASS HOLES OF THE VERMONT YANKEE NUCLEAR POWER PLANT

This memorandum summarizes the NRC staff's evaluation of the mechanical adequacy of core plate bypass hole plugs for insertion into the Vermont Yankee reactor.

Vermont Yankee plans to use the same method and type of plug previously reviewed by the NRC staff for Vermont Yankee and subsequently reviewed by the NRC for use in the Duane Arnold Energy Center Plant.(1)

The plug consists of five basic parts, as shown in Figure 1. Identical plugs have previously been installed at Vermont Yankee, Pilgrim, and Duane Arnold. The body provides a means of guiding the device into the bypass flow holes as well as a shoulder to support the plug and form a seal against water flow. The shaft extends through the body. A knob is provided at the top of the shaft to provide a means of grabbing the plug during installation and extraction. At the bottom, the latch is attached to the shaft by a pin. The latch is free to rotate during installation. The spring acts against the body and shaft during normal operation to provide the force necessary to offset the pressure differential acting on the body.

During installation, the plug has its latch rotated 90 degrees from its installed position and withdrawn and locked in the body. The shaft is gripped by the installation tool, and the plug is inserted into the bypass flow holes. The body engages the rim of the hole. The shaft is pushed to its full extension, thus lowering and unlocking the latch below the underside of the core plate. The latch then rotates 90 degrees and bears on the bottom of the core plate. After insertion, the plug is pulled with about 30-pound force to test the placement.

The plug can be removed by gripping the top of the shaft with an extracting tool and applying a force of about 500 pounds. The latch's legs will be plastically deformed and the entire plug withdrawn. The plugs previously installed at Vermont Yankee were removed with no abnormalities or loose pieces reported. The force required for removal varied from 500 to 1300 pounds

(1) Safety Evaluation of Mechanical Plugs to be Inserted into the Bypass Holes of the Duane Arnold Energy Center Reactor issued June 18, 1975.

Based on a review of the design, the test rig, the installation methods and the previously successful operating experience at Vermont Yankee, Pilgrim, and Duane Arnold, we conclude that the plugs will not fail so as to result in loose parts in the core or result in unplugging of the bypass flow holes. Also, we conclude that the installed plugs will preclude unacceptable channel box damage for at least the proposed fuel cycle. Surveillance programs will be required to confirm the nature and extent of any residual tube excitation and resultant effect, if any, on core components.

Accordingly, we conclude that the installation of the plugs should be authorized. The licensees safety analysis for operation with plugged bypass holes, submitted July 30, 1975 is still under review.

Dated: AUG 15 1975

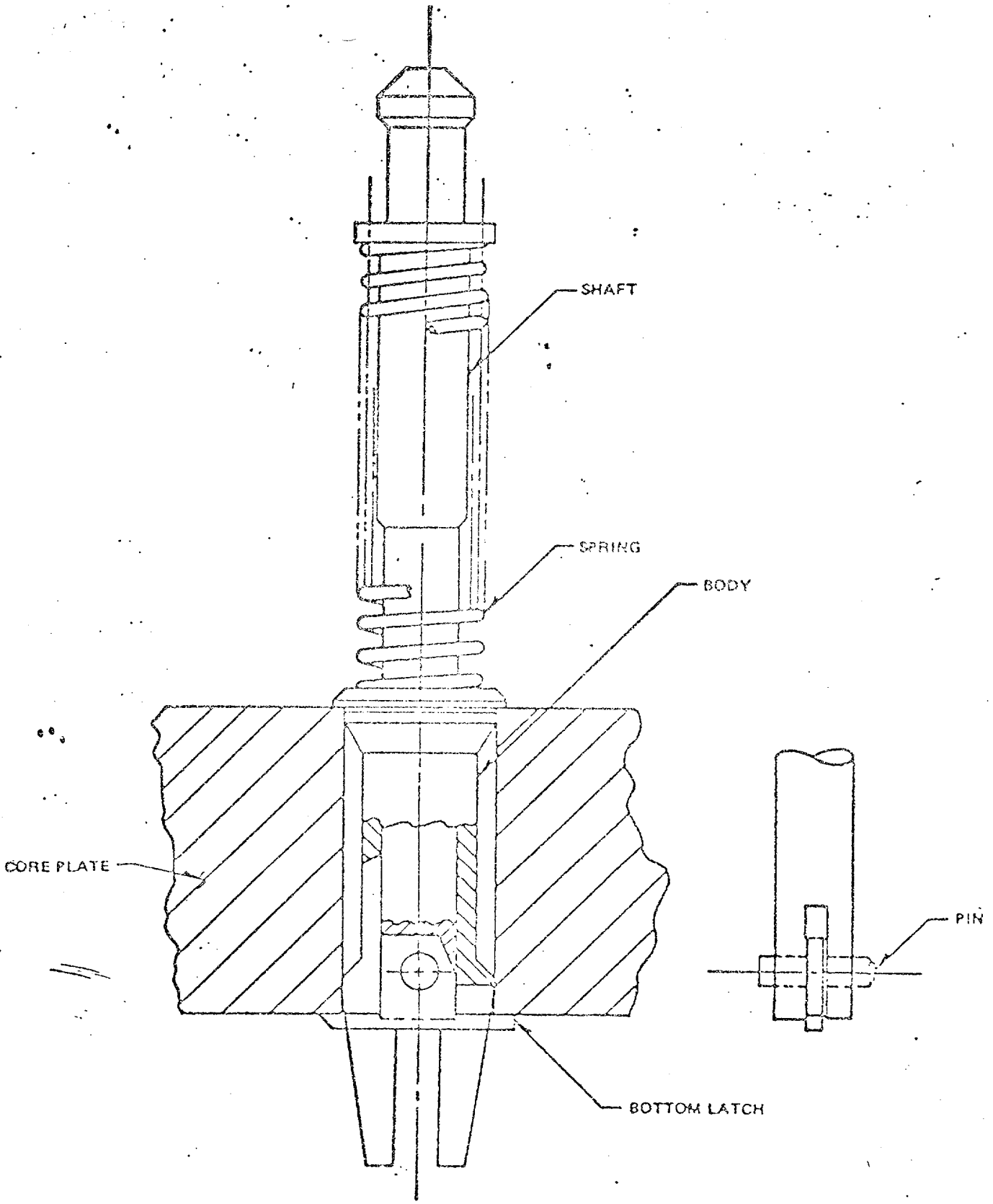

Figure 1. Plug Installed in Core Plate