050-155

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CONSUMERS POWER COMPANY

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R. E. KETTNER
DIRECTOR OF NUCLEAR ACTIVITIES

March 26, 1964

DOCKETED USAEC Division of Licensing & Regulation APR 2 1964 Docket Office

Mr. Robert Lowenstein, Director
Division of Licensing and Regulation
United States Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Lowenstein:

Attached to this letter are three (3) executed and nineteen (19) conformed copies of Proposed Change No. 3 to the Technical Specifications for the Big Rock Point Nuclear Plant.

Yours very truly,

R. E. Kettner

REK/wf

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ACKNOWLEDGED

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CONSUMERS POWER COMPANY

REQUEST FOR AUTHORIZATION OF

CHANGE IN TECHNICAL SPECIFICATIONS

Docket No. 50-155

File Copy (suppl)

Pursuant to 10 CFR 50.59, Consumers Power Company hereby requests the Commission to authorize, as soon as possible after issuance of the full-term operating license for the Big Rock Point Nuclear Plant, the following changes to the Technical Specifications to be incorporated in such license. None of the changes is believed to present significant hazards' considerations not described or implicit in the Final Hazards Summary Report (dated November 14, 1961 and submitted by Amendment No. 3, dated December 1, 1961, to Consumers' Application for Reactor Construction Permit and Operating License) as amended.

CONSUMERS POWER COMPANY

By Robert E Kellner
Director of Nuclear Activities

Jackson, Michigan
March 26, 1964

Proposed Changes

to

Big Rock Point Nuclear Plant

Technical Specifications

1. Delete present Section 1.2, "DEFINITIONS," and substitute the following:

"1.2 DEFINITIONS

Various provisions of these Technical Specifications set fc:th limitations and restrictions which depend upon modes of operation. The following modes of operation are defined to clarify the intent of such provisions, and are not the same as, nor should they be confused with, the positions of the mode selector switch described in Section 6.1.3.

1.2.1 Power Operation - is any operation when the primary system coolant water temperature is 212° F or greater.

1.2.2 Core Alteration - is any completed planned sequence of movements of core components resulting in either a net change in the configuration of the reactor core or a net gain in core reactivity.

1.2.3 Refueling Operation - is any operation with any of the reactor vessel closures open during which a core alteration, or other operation which might increase core reactivity, is in progress.

1.2.4 Major Refueling - is any refueling operation with the head off during which four or more fuel bundles are added, exchanged or repositioned in the reactor core.

1.2.5 Shutdown - is any reactor condition meeting the following requirements:

(a) All or all but one of the control rods are fully inserted in the reactor core; and

(b) Primary system coolant water temperature is less than 212° F.

1.2.6 Cold Shutdown - is a reactor condition involving no fuel in the core, or a reactor condition meeting the following requirements:

(a) All of the control rods are fully inserted in the core and withdrawal prevented by means of the key-lock mode selector switch, the key to which is in the possession of the Shift Supervis ; and

(b) The reactor coolant system is at atmospheric pressure; and

(c) The core shutdown reactivity control margin requirement has been verified in the manner set forth in Section 5.3.2(b)."

Analysis: The proposed definition of "Power Operation" will contribute to ease of interpretation of the Technical Specifications by providing a more definite line of demarcation than exists at present. The frequent references to "core alteration" and "major refueling" suggest that definition of these terms, also, would be desirable. The further addition of "Shutdown" as a defined mode of operation is necessary to avoid confusion in interpretation. Although the three modes defined in the existing Section 1.2 were not intended to cover all possible modes of operation, this fact is not immediately apparent. The definitions now proposed are intended to cover all conceivable modes of operation.

2. Change the first sentence of Section 3.0, "REACTOR CONTAINMENT," to read as follows:

> "Reactor containment shall consist of an externally insulated spherical steel vessel, hereinafter referred to as the containment sphere."

Analysis: There are no other references in the Technical Specifications to "containment vessel" or "containment enclosure."

3. In Section 3.4.3(c), change the closing time for "Main Steam Drain (MO 7065)" from "7.5" to "60" seconds.

Analysis: Experience has shown that the closing speed on this valve from full-open to full-closed exceeds 7.5 seconds. It has therefore been necessary to limit the stroke of the valve in order to meet the 7.5-second limit. Since this valve is normally closed during operation at power, and since the line is only 1-1/2" pipe size, it is believed that operation of the valve at the same speed as the Main Steam Isolation Valve (MO 7050) will not significantly increase any potential hazard.

4. Change Section 3.5.2(c) to read as follows:

> "The proper operation of the automatic valves and associated controls of the spray system shall normally be functionally tested during each major refueling shutdown, but not less frequently than once every 12 months."

Analysis: Reference to the provisional operating license has been deleted. The substitution of "during" for "at" in the third line is made to clarify the original intent of the subsection, which was that the test could be made at any time during such a shutdown, and not necessarily at its beginning.

5. Change Section 3.6, "CONTAINMENT REQUIREMENTS," to read as follows:

> "Containment sphere integrity shall be m..intained during power operation, refueling operation, shutdown and cold shutdown conditions except as specified by a system of procedures and controls to be established for occasions when containment must be breached during cold shutdown."

Analysis: "Shutdown conditions" has been added to conform to the proposed revision of Section 1.2, "DEFINITIONS."

6. In Section 4.1.2(b), change the fourth item in the left-hand column, "Equilibrium Halogen Radioactivity (μc/ml)" to read as follows:

> "Iodine Radioactivity at 2 Hours After Sampling, Based on Efficiency of Counting Equipment to I-131 (μc/ml)"

Analysis: The reference to "equilibrium halogens" in terms of μc/ml presupposes that the various isotopes and the efficiency of counting equipment to each isotope are known. In reality, the iodine separation procedure is utilized and the resultant sample counted. This count is then converted to μc/ml based on the efficiency of the counting equipment to I-131. Thus, the requested change merely expressed the limitation in a more technically correct fashion.

7. In Section 4.1.3, change the last sentence of the first paragraph to read as follows:

> "A removable shield plug of a thickness of 4 feet, 6-1/2 inches, consisting of 4 feet, 4 inches of concrete and 2-1/2 inches of lead, shall close the opening above the top of the reactor."

Analysis: This change merely corrects the description of the reactor vessel shield plug.

8. In Section 4.2.1(a), change the second paragraph to read as follows:

> "The reactor safety system and related circuits are fed from four 120-volt a-c buses. Each of two buses is supplied from a different 480-volt system through its own motor-generator set. Each motor-generator is equipped with a flywheel to sustain operation during momentary power system disturbances. The third bus is supplied from the 125-volt d-c system through a static inverter which supplies power to Neutron Monitoring Channel No. 3. The fourth bus is supplied from the 125-volt d-c system through a motor-generator set which supplies power to the control rod position indicating system. The 125-volt d-c battery system also furnishes power for other critical services including:
>
> Liquid Poison System Controls
> Motor-Operated Automatic Containment Sphere Isolation Valves
> Containment Sphere Ventilation System Isolation Valves
> Emergency Condenser Drain Valves
> Safety System Annunciators
> Emergency Lighting
> Switchgear"

Analysis: This change brings up to date the description of the 120-volt a-c system and reflects the use of a d-c motor-generator set, rather than the inverter, to supply power to the control rod position indicating system. This change was necessitated by the inability of the inverter to supply this load in addition to the No. 3 Neutron Monitoring Channel load.

9. In the third paragraph of Section 4.2.10, change the second sentence to read as follows:

> "During turbine start-up and shutdown, and for short periods of time during normal operation, operation on speed control shall be permitted."

Analysis: The ability to operate on speed control for short periods of time is desirable in order to perform maintenance on the initial pressure regulator (IPR) and to conduct some of the Phase II R&D tests. Tests to date indicate that operation on speed control is stable when the load limiter on the turbine is utilized. The load limiter would be set to limit turbine output to a given reactor power level. Upon decrease of turbine-generator load, the bypass valve would operate as it would during IPR control. Operation of the turbine without the IPR does not alter the safety analyses previously performed for the plant. In addition, those safety analyses were made on the assumption that the bypass valve failed to open, and the effects of such failure were not limiting.

10. In Section 5.1.4, change the second item in the left-hand column, "Available Quantity of Solution, Gallons," to read "Poison Tank Capacity, Gallons."

Analysis: Section 5.1 is entitled "DESIGN FEATURES," and the item in question refers to the design capacity of the tank. The present wording, however, could be interpreted to require that 850 gallons of solution be available at all times. The operating requirement (see Section 5.3.3) is that the equivalent of 850 gallons of 19 weight % sodium pentaborate be available.

11. In Section 5.1.4, change the fourth item, "Initial Injection Gas Pressure, Psia 2080," to read as follows:

"Initial Injection Gas Pressure, Psia

Condition		Pressure
Head Off		500
Relief Valve Settings:		
	1250	1470
	1500	1800
	1750	2080 "

Analysis: As discussed in Mr. R. E. Kettner's letter to Mr. Robert Lowenstein, dated May 17, 1963, the required injection gas pressure on the liquid poison system is a function of the maximum pressure that can be developed within the system, and thus a function of the relief valve settings. The relationship shown above will assure that adequate injection gas pressure is always available to inject liquid poison should the need arise.

12. Change Section 5.3.1(a) to read as follows:

> "The reactor power shall be limited to 2.0 Mwt, exclusive of core decay heat, during operations with the reactor vessel closures open."

Analysis: Instrumentation presently includes a control rod block designed to prevent control rod withdrawal whenever the mode selector switch is in the "refuel" position, with the picoammeter range switches above the 40×10^{-6} position. This position corresponds to a maximum power level of approximately 0.5 Mwt. Physics tests have indicated the desirability of going to higher power levels in order to obtain more meaningful data. A limit of 2 Mwt will allow the interlock to be moved to the next higher range switch position, thus alleviating the power limitation problem while retaining the present control rod block circuit.

13. In Section 5.3.1(b) after "Minimum Recirculation Flow Rate, Lb/Hr" add the following parenthetical phrase:

> "(Except during pump trip tests or natural circulation tests as outlined in Section 8)"

Analysis: Section 8 now provides for the conduct of pump trip tests (i.e., the simultaneous tripping of both recirculation pumps to study the power and flow coastdown characteristics during the transient). During this short period of time (probably less than 15 minutes), the 6×10^6 lb/hr minimum recirculation flow rate will not be met.

Also requested in this submittal is a change to Section 8.2.1 to permit steady-state natural circulation tests. During these tests the 6×10^6 lb/hr minimum recirculation flow rate will not be met.

Under all circumstances, however, all other operating limitations specified in 5.3.1(b) will be met.

14. In Section 5.3.2(a), change the first sentence of the second paragraph to read as follows:

> "The following tests shall be performed during each major refueling shutdown and at least once every six months during periods of power operation."

Analysis: A considerable amount of experience with the Big Rock Point control rod drives and its systemhas been accumulated during the past year. Facts pertinent to the requested relaxation in drive testing frequency include the following:

(1) Response of the control rod drives when jogged in and out has been shown to indicate a change in drive friction with greater sensitivity than any other test.

(2) Scram time on the drives has been very consistent. During the acceptance tests, the average scram speed (from signal initiation to full-in) for the slowest drive was 1.15 seconds and for the fastest drive was 0.84 second. The average scram speed for all drives was 0.93 second. During 1963, drives were scram-timed seven times with the following results:

	Varied From
Fastest Drive	0.80 to 0.88 Second
Slowest Drive	0.95 to 1.25 Seconds
Average of All Drives	0.86 to 0.97 Second

Thus, scram response characteristics are virtually unchanged after more than one year of operation and after many times the number of scrams and normal insertion and withdrawal cycles that can be expected for any future year.

(3) The requirement for accurate timing of drive withdrawal speed at frequent intervals is not necessary, since a significant change in normal insertion or withdrawal speed results in a significant change in jogging response. Also, continuous withdrawal of a co- ol rod is not allowed except during testing with actor subcritical. Thus, the maximum rod withdraw. ate, while the reactor is critical or approaching critical, is actually several times less than the permissible withdrawal speed.

(4) Since March 1963, the drives have operated very well, without any problems with the latching mechanisms or with the rod position indication system. A check of the latching mechanisms and rod position indication every six months, in addition to daily rod exercising,

should be more than adequate to assure continued trouble-free operation.

15. Change the last paragraph of Section 5.3.2(a), to read as follows:

> "The following test shall be performed at least once every 12 months:
>
> Insertion of each drive over its entire stroke with reduced hydraulic system pressure to determine that drive friction is normal."

Analysis: As discussed above, the job response of a drive is sensitive indication of changing conditions within the drive. A friction test once a year will be a more-than-adequate cross-check of drive conditions. The erroneous use of "scope" for "stroke" is corrected in the proposed change.

16. In Section 5.3.2(b), change the third paragraph to read as follows:

> "During power operation, if reactivity and control rod motion data indicate a possible loss of poison from a control rod, the reactor shall be shut down and, if any corrective action is necessary, shall remain shut down in cold condition until such corrective action has been taken."

Analysis: Reference to "cold shutdown" is, in light of proposed changes to Section 1.2, "DEFINITIONS," no longer appropriate. In addition, this proposed change more clearly indicates to the operator the course to be taken following the required shutdown for possible loss of poison from a control rod.

17. In Section 5.3.2(d), insert the words "to be utilized" between the words "rod" and "shall" in the first line of the subparagraph entitled "Routine Coupling Integrity Checks."

Analysis: During refueling or physics tests where only a small portion of the control rods will be utilized, it should be unnecessary to check the coupling integrity of those drives which will not be moved.

18. Change Section 5.3.2(e) to read as follows:

> "Control Rod Exercising During Sustained Power Operation - At least once each day during sustained power operation, the operator shall exercise each control rod that is not at that time fully inserted in the core."

Analysis: This proposed change is editorial in nature, and is not intended to be a substantive revision.

19. Delete the first paragraph of Section 5.3.4.

Analysis: References and requirements relating to initial loading of the core are no longer applicable.

20. Change Section 5.3.4(a) to read as follows:

> "The effect upon reactivity of increasing voids at constant pressure shall be calculated to be always negative."

Analysis: The void test is practical only with a new, completely clean core. The initial void coefficient test served to verify the calculational model for this reactor. It is believed that calculations are now completely adequate to assure that the void coefficient will always be negative for future core loadings.

21. Change Section 5.3.5(a) to read as follows:

> "All rods shall be fully inserted during the reactivity addition. In order to verify the core shutdown margin of 0.3% $\Delta k_{eff}/k_{eff}$ with the most valuable rod completely

> withdrawn, the procedure outlined in Section 5.3.2(b) shall be utilized before and after any core alteration which may result in a net gain in core reactivity. During the reactivity addition, subcriticality checks, consisting of withdrawal of one control rod in the vicinity of the component change, shall be made at the intervals indicated in Section 5.3.5(b)."

Analysis: The proposed changes are editorial in nature, and are intended as a clearer expression of the requirements of existing Section 5.3.5(a). In part, the wording has been changed to accord with the proposed definition, in Section 1.2.2, of "Core Alteration."

22. In the first sentence of Section 6.1.2.1, substitute the words "five decades above source level, without moving detectors" for the words "rated power."

Analysis: The reference to "rated power" is erroneous, since the range of the start-up channels is five decades.

23. In the last line of Section 6.1.2.2, substitute "2.2×10^{-14}" for "4×10^{-14}."

Analysis: This proposed change reflects the sensitivity of the installed CICs. No change in instrumentation response is involved.

24. Change the last sentence of Section 6.1.2.3 to read as follows:

> "The detectors shall be gamma-compensated ion chambers with a sensitivity of 2.2×10^{-14} amperes/nv. The amplifier output shall be connected to the reactor safety system."

Analysis: This change likewise reflects the present sensitivity of the CICs. It is also more correct technically, since the CIC output is fed to a picoammeter whose trip circuit is connected to the reactor safety system.

25. For the last two sentences of Section 6.1.2.4, substitute the following:

> "Annunciation shall occur when the maximum heat flux in the zone assigned to a particular in-core monitor reaches 105% of rated (steady-state) heat flux."

Analysis: It is more meaningful to adjust the meters to indicate a value proportional to the average heat flux in the neighborhood of the monitor. The instrument reading at which the maximum heat flux in the zone reaches rated conditions is determined from the ratio of maximum to average heat flux in each zone.

26. Change Section 6.1.2.5, "Neutron Monitoring Range Switch," to read as follows:

> "The range switches on the three power level instruments contain resistor-capacitor feedback circuit combinations which can be switched to provide nine decades of overlapping power level indication. The unit also contains interlock contacts used in conjunction with the upscale-downscale trip units of the picoammeters."

Analysis: The proposed change renders the description more technically correct.

27. In Section 6.1.3, change the second sentence of the introductory paragraph to read as follows:

> "A key-lock reactor mode switch shall be provided, having 'Shutdown,' 'Refuel,' 'Bypass Dump Tank' and 'Run' positions."

Also, under the tabulation of functions, delete the position "Start-Up" and its trip function "None (e)." Add the reference "(e)" to the trip function for "Run."

Analysis: The "Start-Up" position of the mode switch has no function, and therefore should not be required.

28. Change Section 6.1.5(a) to read as follows:

> "Except as otherwise provided in these Technical Specifications, the reactor safety system shall be operable during power operation as indicated in Section 6.1.2. This system shall be functionally tested during each major refueling shutdown, but not less frequently than once every 12 months, and in addition shall be tested not less frequently than once a month using the switches provided to simulate sensor trips."

Analysis: This rewrite more specifically describes the monthly tests of the reactor safety system. By tripping one channel at a time, the entire scram portion of the reactor safety system can be checked, except for the sensors and connecting leads.

29. Change Section 6.1.5(b) to read as follows:

> "The core spray system and emergency condenser control initiation sensors shall be functionally tested not less frequently than once every 12 months."

Analysis: It is proposed that a yearly test be substituted for a test at each major refueling shutdown. It is believed that a check once a year is sufficient to assure continued proper operation of this system.

30. In Section 6.1.5(d), change the second sentence to read as follows:

> "For reactor operation above approximately 5% of rated power, the logarithmic neutron flux level information and period scram protection are not required (see Section 6.1.2)."

Analysis: This proposed change is merely editorial in nature.

31. Change Section 6.1.5(h) to read as follows:

> "Minimum nuclear instrumentation in operation during shutdown operation shall be the same as that required for refueling operation, except that only one start-up range monitor shall be required."

Analysis: This change is also editorial in nature, reflecting the proposed changes in Section 1.2, "DEFINITIONS." No change in instrumentation requirements is involved.

32. In Section 6.2.2, change the last sentence to read as follows:

> "Permissive circuits shall be functionally tested not less frequently than once every 12 months."

Analysis: No problems have been encountered with the control rod withdrawal permissive circuits to date. Functional testing once a year should prove adequate to assure proper operation.

33. In the parenthetical phrases in Sections 6.3.2(a) and (b), delete ", and monorail crane."

Analysis: Experience has shown that movement of fuel into or out of the core via the monorail crane is neither necessary nor desirable. Furthermore, plant administrative procedures prohibit its use for this purpose.

34. In the last sentence of the second paragraph of Section 6.4.1(a), substitute "10^{-4} to 10" for "10^{-3} to 100," and change the last paragraph to read as follows:

> "A trip circuit in the air ejector off-gas monitor shall have an alarm which shall annunciate in the control room. The air ejector off-gas monitor trip circuit shall also initiate action of a time-delay switch, which in turn shall trip the off-gas shutoff valve closed after a preselected delay adjustable up to 15 minutes. (Off-gas average hold-up time is about 30 minutes.) Alarm and trip settings shall be as specified in Section 6.4.3(a)."

In the fourteenth line of Section 6.4.1(b), substitute "10^{-4} to 10" for "10^{-3} to 100."

Analysis: Experience has shown that it is impractical to try to extend the range of the off-gas and stack-gas monitors to 100 curies per second. The proposed upper limit of 10 curies per second is quite adequate and still well above the operating limit of 1 curie per second. The upper limits of the alarm settings have been adjusted downward accordingly (see proposed amendments to Section 6.4.3). The reference to alarm settings has been deleted from Section 6.4.1(a), and the last paragraph reworded accordingly, since these settings are specified in Section 6.4.3(a) under "Operating Requirements."

35. In the eleventh line of Section 6.4.3(a) and in the eighth line of Section 6.4.3(b), substitute "5 curies" for "10 curies."

Analysis: The maximum permissible alarm setting should be reduced from 10 curies/second to 5 curies/second so as to be well within the proposed upper limit of 10 curies/second on the off-gas and stack-gas instruments.

36. In Section 6.4.3(e), substitute the following for the last two sentences in the second paragraph:

> "The films at each station shall be replaced and analyzed at least monthly."

Also, change the last two sentences of the third paragraph to read as follows:

> "One film at each station shall be replaced and analyzed at least every two weeks. The second film shall be replaced and analyzed monthly."

Analysis: Experience with the three-month films has shown that latent image fading occurs. It is, therefore, proposed to process and replace both films at least monthly.

37. In the last sentence of Section 6.4.3(f), substitute "once every three months" for "monthly."

Analysis: Experience with this instrumentation shows very little need for monthly calibration. Quarterly calibrations will provide sufficient accuracy and will eliminate needless radiation exposure of calibration personnel.

38. In Section 6.5.4(a), change the first line of the second paragraph to read as follows:

> "The annual average stack release rate for iodine (based on the efficiency of counting equipment to I-131)."

Analysis: As discussed relative to change Item No. 6 above, the iodine analyses are based on efficiency of counting equipment to I-131.

39. In Section 7.0, "OPERATING PROCEDURES," change the introductory paragraph to read as follows:

> "This section describes those basic operating principles and procedural safeguards which have a potential effect on safety. Operating principles and procedures are presented for normal and emergency operation of the plant, for Phase II testing within the Research and Development Program, and for operational testing of the nuclear safeguards systems of the plant."

Analysis: In the first line, "plant operating procedures" is changed to "basic operating principles" to conform to the heading for Section 7.1 and to reflect the fact that many plant operating procedures and safeguards having "a potential effect on safety" may not be included in the Technical Specifications; detailed written operating procedures may fall into this category. The paragraph has also been modified to remove reference to initial start-up of the plant and to include reference to Phase II of the Research and Development Program.

40. In the first line of Section 7.2.3, delete the words "Review of."

Analysis: Since "shall be reviewed" appears in the second line, the deleted words are redundant.

41. In the second sentence of Section 7.3.2(i), delete the phrase "and the reactor reaches rated pressure,".

Analysis: This step is unnecessary and time-consuming. After sealing steam is available and condenser vacuum is established, the turbine speed and reactor pressure can be brought up together. Such a procedure will in no way adversely affect plant safety.

42. Change Section 7.4(a) to read as follows:

"Detailed written procedures shall be used."

Analysis: The present wording implies that the procedures shall be available prior to the plant shutdown. Since final details of a refueling are often incomplete at the time of the shutdown, the proposed wording establishes a more realistic requirement.

43. Change the second paragraph of Section 7.4(b), to read as follows:

"Fuel shall be replaced according to the following sequence:

(i) Removal of selected bundles from core and transfer to spent fuel storage.
(ii) Reshuffling of remaining bundles in core as desired.
(iii) Insertion of new bundles in vacant positions as desired.

Shutdown margin verifications and subcriticality checks shall be made as required by Section 5.3.5."

Analysis: The refueling procedure as originally written covered only the normal operations and did not take into account special refueling operations during the R&D period, the special operations for fuel inspection, etc. The proposed changes will allow more latitude for fuel moves and result in a more efficient operation. "Assembly" has been changed to "bundle" for the sake of uniformity.

44. Change the second paragraph of Section 7.4(c), to read as follows:

> "No additional instrumentation need be placed within the core lattice if the out-of-core instrumentation produces a significant response to the subcriticality check in the region to be altered. If this criterion cannot be met, a low-level neutron detector, measuring neutron flux, shall be located near the region to be altered."

Analysis: The existing requirement is less than clear. The proposed change will provide personnel with a clearly defined ground rule and will provide adequate neutron instrumentation during refueling operations.

45. Change Section 7.5.7, to read as follows:

> "It shall be permissible to remove a control rod drive from the core when the reactor is in the shutdown condition. The core shutdown margin of 0.3% $\Delta k_{eff}/k_{eff}$ with the strongest rod out of the core shall be met and equipment shall be properly tagged. The drive removed, or a replacement drive, shall be reinserted within 24 hours following removal."

Analysis: This proposed change clarifies the drive removal procedure and allows drive removal under the newly defined "Shutdown" condition. The existing Section 7.5.7 is incompatible with the definition of "Cold Shutdown," in that the latter requires all rods to be inserted. The 24-hour limitation on drive removal will allow a drive to be removed, inspected, and then reinserted if this is more desirable than inserting a spare drive.

46. In the "Range" column in the first paragraph of Section 8.2.1, as amended, opposite "Recirculation Flow Rate," change "6×10^6 to Full 2-Pump Flow" to "Natural Circulation to Full 2-Pump Flow."

<u>Analysis</u>: During Phase II of the R&D Program, it is proposed that selected tests be conducted under conditions of natural circulation in the Big Rock Point reactor. The nuclear steam supply system incorporates features which assure suitable and safe operation for this recirculation flow mode.

Principal among these features is the high steam drum design which provides a substantial driving head for the flow loops. The resulting flow is sufficient to permit the reactor to operate safely at relatively high power levels, depending on core configuration.

A second important feature, unique to this plant, is the recirculation flow sensing instrumentation. These sensors permit continuous accurate evaluation of existing flow conditions, thereby providing direct confirmation of pretest analytical predictions. This is a direct contribution to safe operation of this plant under the conditions of natural circulation.

During the operation of Big Rock Point to date, there has been no sustained natural circulation operation, although certain test experience is directly applicable. As part of the start-up testing, the recirculation flow coastdown and power coastdown characteristics were observed while tripping both recirculation pumps. In all such cases of pump trips, the minimum burnout ratio of 1.5 was met or exceeded throughout the transient as well as in the steady-state terminal condition. Although the pumps were brought back into service as soon as test data were taken (5 to 10 minutes), there were short periods at low power levels (up to 60% of rated) where the plant operated at steady-state natural circulation conditions. During such operation, there have been no observable indications, for example, by neutron flux noise, that the system is underdamped. This limited operation with natural circulation has been characteristic of that observed during forced circulation performance testing and steady-state operation.

The selected natural circulation tests to be conducted at Big Rock Point will be performed at discreet steady operating conditions. Core performance, i.e., minimum burnout ratio, thermal power, quality, etc, will be evaluated and control rod oscillator data will be taken at the selected operating points in the natural circulation mode. The approach to maximum power with any given core size, nominally the two cores of 84 and 41 bundles, will be done by a stepwise increase-in-power or decrease-in-flow procedure. Before proceeding to the next test, each change will be examined with respect to previous analysis and to previous tests to assure compliance with operating limits and operational safety.

Natural circulation operation involves continuous steady operation with no pumps functioning, and at recirculation flow rates automatically determined by the power level and subcooling of the system. These flow rates will be less than the minimum allowed under conditions of forced circulation, i.e., less than 6.0×10^6 pounds per hour. The natural circulation mode will most probably be initiated by tripping the recirculation pumps from a normal operating point.

The natural circulation tests to be conducted will involve no significant transient testing. Control rod oscillator tests will introduce only small perturbations in reactivity that will not materially alter the steady power operation of the reactor. Core performance evaluation involves only the measurement, interpretation, and analysis of the steady operating state and requires no major disturbance from that condition.

Pump trip testing has been previously defined as part of performance testing in the new Technical Specifications, Section 8.2.2. In those transient tests the objective is the time rate of change of flow and heat flux immediately following the pump trip. The terminal condition after pump trip is a natural circulation flow rate which is below the minimum allowed under forced circulation conditions. This results in relatively low power and flow conditions where substantial burnout margin exists. Since this steady-state condition is of relatively little interest in terms of objective of the natural circulation testing program, the pumps are returned to service immediately after the transient pump trip data have been adequately recorded.

Analysis of selected operating conditions for Phase II of the R&D Program has included an investigation of the stability and thermal hydraulic characteristics of natural circulation operation. These are summarized in the following table for typical cases corresponding to two core configurations. The effect of the planned orifice pattern on core flow and power distribution is fully considered in the cases discussed.

Typical Natural Circulation Operation During Phase II

Core Size	84 Bundles	41 Bundles
Power Level	190 Mwt	120 Mwt
Recirculation Flow	4.9×10^6 Lb/Hr	4.0×10^6 Lb/Hr
Minimum Burnout Ratio	1.79	2.04
Stability Phase Margin	34.5 Degrees	84.2 Degrees

84-Bundle Core

Various conditions of natural circulation operation with the large core have been analyzed. A typical result, as shown in the table, indicates that power levels in excess of 190 Mwt are attainable without exceeding normal operating limits, including burnout ratio and stability. With reference to the example cited in the table, a reduction in power level results in a corresponding reduction in the natural circulation flow rate. The power-to-flow relationship, however, is such that the minimum burnout ratio increases with this decrease in operating power level.

The calculated phase margin of 34.5 degrees for the cited 190 Mwt natural circulation operation is in fact even greater than that for calculated full power forced circulation operation with this core. The analytical results indicate that transient system behavior will be very satisfactory and should be essentially the same in either flow mode. For this analysis, the void coefficient was assumed relatively high as a measure of conservatism in the calculation.

41-Bundle Core

The cases evaluated for the 41-bundle core have shown that this core can be operated in natural circulation at power levels above 120 Mwt without exceeding any operational limit, exclusive of the 6.0×10^6 pounds per hour recirculation flow limit imposed for forced circulation. Any tests conducted with this or any larger core will be analytically determined to always be within these limits.

The margin of stability for the smaller core in natural circulation is calculated to be even greater than for the large core. The phase margin of 84.2 degrees is among the largest encountered in any studies conducted for the Big Rock Point Nuclear Plant. On this basis, and enforced by the inherent conservatism of the analysis, no indication of stability problems is expected to be encountered during the natural circulation mode of operation.

The pertinent reactor operating limits imposed in Section 8.3 of the Technical Specifications will be observed during the proposed testing and during subsequent natural circulation operation. One limit which obviously does not apply is the 6.0×10^6 pounds per hour minimum recirculation flow rate imposed for forced circulation operation. In the absence of this unapplicable limit, as is also the case for pump trip transient testing, all natural circulation tests will be judged as to safety with regard to flow rate in terms of the minimum burnout ratio. The 1.5 minimum burnout ratio will be shown by analysis to be observed for any test or operating sequence encountered at Big Rock Point.

47. In Section 8.2.2.2 add a new paragraph.

> "For use with this small core, the source positions as specified in 5.1.6 will not apply. The source positions planned for use with this core are 02-53 and 09-58. However, the sources may be repositioned slightly as necessary to meet required count rate and visibility requirements."

Analysis: The core for the high power density demonstration will require that the sources be relocated from the positions specified for the 84-bundle core. This small core will result in about the same water gap as was present with the 56-bundle core, and will require that the sources be located near the positions indicated above. To allow for possible small changes in the size and ultimate configuration of this core, the ability to move the sources slightly is needed. Under all conditions, the present count rate and visibility requirements will be met.