07-269-91

NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT NUCLEAR STATION UNIT 2

OPERATIONS DEPARTMENT INSTRUCTION

N2-ODI-7.01

REVISION 01

REACTIVITY MANAGEMENT PROGRAM

Approved By:
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Manager, Operations, Unit 2

7/31/91
Date

THIS IS A FULL REVISION

Effective Date: August 1, 1991

NOT TO BE USED AFTER August 1995
SUBJECT TO PERIODIC REVIEW

5/6/35

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1.0 PURPOSE

(NCTS 1)

(COMM 2) To provide for the safety and health of the general public by minimizing the possibility of a reactivity accident.

To ensure adequate protection of the reactor core by defining the process core reactivity and reactor power may be changed including plant startups, power operation, controlled plant shutdowns, and refueling.

To provide guidance on the use of reactivity controls during off-normal/emergency situations.

1.1 Applicability

This procedure applies to personnel that:

a. Manipulate reactivity control systems.

b. Perform maintenance, surveillance, or modifications on systems that potentially have an affect on core reactivity or reactivity systems.

1.2 Exclusions

1.2.1 Modification Coordinators are excluded from ensuring Modifications and Simple Design Changes potentially affecting reactivity are reviewed by the Supervisor Reactor Engineering until September 1, 1991.

1.2.2 Department Supervisors are excluded from ensuring training programs are provided for personnel having daily activities potentially involving reactivity changes or working on systems that could cause a reactivity change until January 1, 1992.

1.2.3 Until the new STA program is fully implemented, Reactor Engineers will perform the functions assigned to STAs in this procedure.

2.0 REFERENCES AND COMMITMENTS

2.1 Licensee Documentation

Unit 1 and 2 Technical Specification

2.2 Standards, Regulations, and Codes

ANSI/ANS-3.1-1978, Qualifications of Nuclear Power Plant Personnel

2.3 Policies, Programs, and Procedures

2.3.1 AP-10.1, Management of Station Records

2.3.2 AP-10.2.2, Occurrence Reporting

2.4 Technical Information

2.4.1 INPO SOER 88-2, Premature Criticality Events During Reactor Startup

2.4.2 INPO Case Study 87-015, Control Rod Mispositioning and Reactivity Events

2.4.3 INPO Case Study 89-007, Reactivity Mismanagement

2.4.4 Banked Position Withdrawal Sequence (BPWS) - GE Licensing Topical Report NEDO-21231

2.4.5 General Electrical Station Nuclear Engineer's Manual NEDO-24810C

2.4.6 General Electric SIL 316, Reduced Notch Worth

2.4.7 General Electric PCIOMR Manual, NEDE-21493, Rev 5

2.4.8 SER 22-89, Miscalibration of Nuclear Detectors by Repositioning

2.5 Commitments

Sequence Number	Commitment Number	Description
1	003704-01	Create and train on a reactivity management program.
2	SOER 84-2	This procedure is a barrier pertaining to reactivity management, control rod manipulation.

3.0 DEFINITIONS

3.1 Banked Position Withdrawal Sequence (BPWS)

3.1.1 The rod sequencing rules followed between "ALL-RODS-IN" and the Low Power Set Point (LPSP) to assure compliance with the Control Rod Drop Accident Analysis.

3.1.2 The methodology used to withdraw control rods from the 100 percent control rod density point to low power setpoint that results in incremental control rod reactivity worth so peak fuel enthalpy resulting from a control rod drop is below 280 cal/gm.

3.2 Control Rod Exercising Instructions

Instructions for conducting rod exercising accounting for fuel preconditioning and other requirements.

3.3 Core Reactivity Control (CRC) Book

A binder located in the Control Room, provided to the Operating Shift by the Supervisor Reactor Engineering and maintained in accordance with Reactor Engineering Instructions. The CRC book contains:

- Reactor Operating Instructions
- Startup Control Rod Movement Instructions, if applicable
- Shutdown Control Rod Movement Instructions, if applicable

3.4 CRAM Rods

High worth control rods used for rapid power reductions in an emergency/off-normal situation.

3.5 Deep Control Rod

A control rod inserted to between position 24 and 00

3.6 Fuel Preconditioning Recommendations

Special recommendations on power increases provided by the fuel vendor to prevent fuel damage resulting from Pellet-Clad-Interaction.

3.7 Mispositioned Rod

A control rod found to be left in a position other than the intended position and not identified/corrected before or during the confirmation step of the rod movement sheets.

3.8 Reactivity Controls

Hardware or administrative controls to ensure reactivity changes are performed within the bounds of analysis.

3.9 Sequence

One of four groupings of control rods defining which rods are inserted and if inserted, deep or shallow.

3.10 Shallow Control Rod

A control rod inserted to between position 30 and 48

3.11 Shutdown

All rods inserted to 02 or beyond. If shutdown margin for the current cycle has been demonstrated, this definition could be met if all rods except one are inserted to position 00. The remaining rod can be at any position.

3.12 Startup/Shutdown Control Rod Movement Instructions

Instructions to achieve the Target Control Rod Pattern from the ALL-RODS-IN condition or to direct control rod insertions to the ALL-RODS-IN position. These instructions:

- Implement the Banked Position Withdrawal Sequence (BPWS).
- Control deviations from the BPWS above the low power setpoint.
- Ensure a monitored approach to criticality.
- Document reactivity changes.

3.13 Target Control Rod Pattern

The control rod pattern, developed by calculation, expected at 100 percent power with the desired flow.

3.14 Turbine Valve Testing Instructions

Instructions for required power drops and returning to rated power associated with the test accounting for fuel preconditioning and other requirements.

4.0 PRIMARY RESPONSIBILITIES

The Supervisor Reactor Engineering controls and verifies proper implementation of the Reactivity Management Program.

5.0 PROCEDURE

5.1 General Requirements

5.1.1 The Supervisor Reactor Engineering shall provide the STA with reactor engineering related information and guidance on issues affecting reactivity.

5.1.2 In the absence of the Reactor Engineer, the STA shall perform routine Reactor Engineering functions.

5.1.3 The Supervisor Reactor Engineering shall ensure a qualified Reactor Engineer is on-call with the Control Room when the plant is in both the startup and power operation modes.

5.1.4 The Modification Coordinator shall ensure Modifications and Simple Design Changes to plant systems that control, monitor, or affect reactivity are reviewed by the Supervisor Reactor Engineering.

5.1.5 Department Supervisors shall ensure training programs are provided for personnel having daily work activities potentially involving reactivity changes or working on systems that could cause a reactivity change including:

a. Instruction on reactivity

b. How the individuals work could affect reactivity

c. The consequences of an unexpected/inadvertent reactivity change.

5.1.6 The STA shall:

a. Monitor core parameters and control rod movements.

b. Review the Reactor Engineering Daily Fuel Surveillance.

c. Monitor the accuracy of thermal limit computer programs and other process computer edits used by shift operations personnel.

d. Monitor LPRMs. (Information Only)

e. Input/cancel substitute control rod positions in the process computer, as necessary.

f. Monitor the proximity to the restricted zone of the power to flow map and monitor for thermal hydraulic instabilities if the restricted zone is entered.

g. Monitor core alteration activities.

h. Direct the bypassing of failed or drifting LPRMs.

i. Monitor and maintain an awareness of SRM performance during core alterations and notify the SSS and the Supervisor Reactor Engineering of high or low count rates, criticality concerns, or signal-to-noise concerns.

j. Perform routine reactor power calculations via manual heat balance when requested by Reactor Engineering. (Information Only)

k. Ensure validity of all Reactivity Maneuver Request Forms and remove any which have expired or which he deems not applicable.

5.1.7 The STA, with authorization or assistance from the Supervisor Reactor Engineering, may:

a. Direct the restoration of bypassed LPRMs to service.

b. Input substitute values for failed process computer input sensors.

5.1.7 (Cont)

c. Assist in control rod scram time testing.

d. Assist in control rod friction testing.

e. Initiate recovery from transients or off-normal events.

f. Approve changes to Reactor Engineering procedures.

5.1.8 The Station Shift Supervisor shall:

a. Ensure briefings for work activities involving reactivity changes or work on systems that could cause a reactivity change are conducted and include:

1. How work could affect reactivity.

2. The consequences of an unexpected/inadvertent reactivity change.

b. Ensure reactivity changes are made by a licensed Reactor Operator, Senior Reactor Operator, or a qualified trainee.

c. Ensure supervision of reactivity changes in the "At the controls" area of the Control Room by a Senior Reactor Operator.

d. Notify the Supervisor Reactor Engineering of unplanned reactivity changes.

5.1.9 Department Supervisors shall ensure Technical Specification changes, programs, evolutions, and procedures involving reactivity changes or having the potential to cause reactivity changes:

a. Are reviewed by the Supervisor Reactor Engineering.

b. Are designated/identified as Reactivity Related.

5.1.10 Reactor Engineers shall:

a. Provide direction to the SSS for control rod withdrawal and power maneuvers above the low power setpoint.

b. Perform fuel integrity monitoring.

c. Provide core operating recommendations to optimize thermal capacity factor within legal, contractual, and operation constraints.

d. Control the process computer NSSS package and perform alternate computations methods.

e. Verify the Shutdown Margin calculation.

5.1.10 (Cont)

f. Monitor core alterations from the refuel floor in conjunction with technicians.

g. Approve all changes in core component or fuel movement instructions.

h. Direct all post refueling reactor physics testing.

i. Review post refueling core verification.

5.1.11 The Reactor Engineer or STA shall immediately notify the SSS upon:

a. Violation of a Reactor Engineering related Technical Specification.

b. Failure of a component or instrument which may affect a core component.

c. Failure of the process computer that would inhibit its use in supporting Reactor Engineering functions.

d. Violation of General Electric PCIOMRs.

e. Situations of a reactor engineering nature that affect plant operations.

5.1.12 The STA shall immediately notify the Reactor Engineer upon:

a. Violation of a Reactor Engineering related Technical Specification.

b. Situations of a reactor engineering nature that affect plant operations.

c. Unplanned power changes as a result of a plant transient or deliberate power changes involving control rod movement or core flow changes in response to a plant transient.

d. Operational events involving Reactor Engineering concerns. These events shall include, but not limited to, stuck, uncoupled, mispositioned or inoperable control rods and significant increases in off-gas activity.

e. Before unplanned work is performed on the Process Computer or neutron monitoring instrumentation.

f. Failure of a Process Computer sensor which provides an input to the reactor heat balance or thermal limit calculations.

5.1.13 Operators shall conduct control rod movements in accordance with:

a. Reactivity Maneuver Requests (Attachment 1) or,

b. Other approved procedures

5.1.14 Operators shall conduct recirculation flow changes at greater than 25% power in accordance with:

a. Reactivity Maneuver Requests (Attachment 1) or,

b. Reactor Operating Instructions or,

c. Other approved procedures

5.1.15 Except during emergencies, a qualified Reactor Engineer shall provide guidance for reactivity changes (with rods or flow) at power levels greater than the low power setpoint.

5.1.16 Reactor Engineering personnel shall prepare Control Rod Startup/Shutdown Sequences.

5.1.17 Before issue, the Supervisor Reactor Engineering shall review and approve Control Rod Startup/Shutdown Sequences.

5.1.18 Except for activities specified in Reactor Operating Instructions, other approved procedures or plant shutdowns, the Reactor Engineer shall complete and the SSS shall approve a Reactivity Maneuver Request (Attachment 1) for all recirculation flow changes.

5.1.19 Once a Reactivity Maneuver Request is approved for a Startup, the Startup Control Rod Sequence may only be altered if the Reactor Engineer and SSS concur and initial the changes on the working copy in the comments section. Reason for the change shall be noted in the Reactor Engineering Log Book.

5.1.20 The Reactor Engineer may use Individual Control Rod Movement Sheets to list the control rods to be moved and the "from" and "to" positions for rod motion for situations such as:

- High power rod pattern adjustments
- Setting the target pattern on startups for the current xenon condition
- Special rod motion required because of unexpected operating conditions
- Rodline control

5.1.21 When Individual Control Rod Movement Sheets are used, personnel shall ensure the sheets are:

a. Approved by a Reactor Engineer.

b. Used in conjunction with an approved Reactivity Maneuver Request Form (Attachment 1).

5.1.22 Following completion of rod maneuvers, a Reactor Engineer or STA shall ensure the Reactor Operating Instructions are updated as appropriate. The STA shall ensure that the completed Reactivity Maneuver Request is removed from the Core Reactivity Control Book. If the STA is unavailable, a licensed Reactor Operator shall remove the completed form and transfer it to the STA's desk.

5.2 Core Reactivity Control Book

5.2.1 A qualified Reactor Engineer shall control changes to the CRC Book.

5.2.2 The STA shall update Reactor Operating Instructions following completion of rod pattern adjustments or as required by the Supervisor Reactor Engineering.

5.2.3 Once per regular workday, a Reactor Engineer shall review and initial Reactor Operating Instructions indicating continued applicability.

5.2.4 The Chief Shift Operator (CSO) shall review Reactor Operating Instructions during shift turnover.

5.2.5 The Supervisor Reactor Engineering shall ensure the Reactor Operating Instructions contain, as a minimum:

a. Identification of CRAM RODS.

b. Turbine Valve Testing Instructions

c. Control Rod Exercising Instructions

d. Rod Maneuvers to Maintain Power Instructions (Reactivity Maneuver Request)

e. Recirculation Flow Changes to Maintain Power Instructions

f. Special Instructions/Precautions as necessary

5.2.6 The SSS shall notify the on-call Reactor Engineer as soon as possible following CRAM ROD insertions.

5.2.7 The Reactor Engineer shall ensure the Shutdown Control Rod Movement Instructions are in the CRC book when the plant is at high power, steady state conditions.

5.2.8 When steady state power operation is commenced or resumed, the STA shall ensure the CRC Book is up to date.

5.3 Reactivity Controls During Reactor Startups

5.3.1 The Supervisor Reactor Engineering shall ensure a Reactor Engineer is present in the Control Room when the plant is approaching criticality.

5.3.2 Before rod withdrawals for criticality and plant startup, Operators shall obtain an approved Reactivity Maneuver Request form (Attachment 1) and approved Startup Control Rod Movement Instructions.

5.3.3 Below the low power setpoint, if any rod insertions and subsequent re-withdrawals are required due to operating concerns or limitations, Operators shall:

a. Perform the rod movement in the exact order of the pull sheets.

b. Document the rod movement in the rod insert column.

5.3.4 A qualified Reactor Engineer shall direct rod withdrawals and recirculation flow changes above low power setpoint in accordance with the Reactivity Maneuver Request Form.

5.3.5 Before making power increases above 25% power with control rods or by increasing recirculation flow (except for power changes made in accordance with Reactor Operating Instructions) Operators shall notify Reactor Engineering personnel.

5.3.6 Once steady state power is reached, operations personnel may maintain power level using recirculation flow and control rods per the Core Reactivity Control Book.

5.4 Reactivity Controls During Controlled Shutdowns

NOTE: A reactivity maneuver request is NOT required for a reactor shutdown.

5.4.1 Operators shall insert control rods in accordance with an approved shutdown Control Rod Movement Instructions (or reverse order of the Startup Control Rod Movement Instructions if a startup is in progress).

NOTES:
1. Guidance to ensure compliance with BPWS below the low power setpoint is contained in the Core Reactivity Control Book.

2. The shutdown sequence step numbers are performed in descending order such that Step 1 is the last step before ALL-RODS-IN.

5.5 Reactivity Controls During Rod Pattern Adjustments and Sequence Exchanges

NOTE: Reactivity controls for control rod sequence exchanges and/or control rod pattern adjustments include:

a. An approved Reactivity Maneuver Request form (Attachment 1).

b. Approved Individual Control Rod Movement Sheets establishing the required rod pattern before the exchange when required.

5.5.1 Personnel shall ensure power changes with recirculation flow made before, during, or subsequent to control rod maneuvers are documented on the Reactivity Maneuver Request Form.

5.6 Reactivity Controls During Emergency Power Reductions, Shutdowns, and Off-Normal Plant Conditions

5.6.1 The Supervisor Reactor Engineering shall ensure instructions for emergency power operations are provided to operators in accordance with Reactor Engineering/Operating procedures.

5.6.2 The SSS shall notify the on-call Reactor Engineer as soon as possible of emergency power reductions.

5.6.3 To avoid power peaking and fuel preconditioning problems at intermediate positions, Operators shall fully insert CRAM rods to position 00 in the continuous mode.

NOTES:
1. CRAM rods are used for quick rod line reductions such as during loss of condenser vacuum, power oscillations, etc.

2. In an emergency/off-normal situation where procedures direct the insertion of CRAM rods, the second verifier is not required.

5.6.4 If a plant shutdown is required, Operators should decrease flow and insert control rods per the "Reactivity Controls During Controlled Shutdowns" section of this procedure. If there is not sufficient time to insert control rods in the exact order of the shutdown sequence, Operators should consider a manual scram.

5.6.5 During an event where core reactivity may be affected, Operators shall use the off-normal sections of the appropriate operations procedures for direction (Examples: loss of feedwater heaters, control rod drift, etc.).

5.6.6 Operators shall recover from an inadvertent or intentional control rod insertion using appropriate department procedures.

5.7 Reactivity Controls During Refueling Outages

5.7.1 Unless instructed by an approved procedure, Operators shall perform control rod movements made in accordance with an approved Reactivity Maneuver Request form and Control Rod Movement Sheets.

5.7.2 Personnel shall perform core alterations and associated activities in accordance with approved procedures.

5.8 TIP Operation

5.8.1 The SSS shall authorize operation of the TIP machines.

5.8.2 Before and after completion of TIP system operation, personnel shall notify Radiation Protection personnel.

NOTE: TIP operation is normally done by a Reactor Analyst Technician or by shift operations personnel under the direction of the Reactor Engineer.

5.9 APRM Gain Adjustments

5.9.1 The Reactor Analyst Technician or shift operations personnel shall perform APRM gain adjustments.

5.9.2 Any APRM gain adjustments shall be made in accordance with approved procedures.

5.10 Process Computer

5.10.1 The Lead Computer System Engineer AND the Reactor Engineer shall approve changes to the NSSS Data Classes constants.

5.10.2 Computer System Engineering personnel shall assist Reactor Engineering in changing the process computer data bank.

5.10.3 The Supervisor Reactor Engineering, in conjunction with Computer System Engineering personnel shall:

a. Before Beginning of Cycle (BOC) Startup, verify key NSSS data classes.

b. Maintain a historical log of changes to the data bank constants.

6.0 RECORD REVIEW AND DISPOSITION

6.1 During the current operating cycle, the Supervisor Reactor Engineering shall retain core reactivity control records and forms.

6.2 Operations personnel shall transfer completed core reactivity control forms to the STA for later retrieval by Reactor Engineering personnel.

6.3 Following the completion of the operating cycle, the Supervisor Reactor Engineering shall ensure records documenting core reactivity changes are transmitted to document control in accordance with AP-10.1, Management of Station Records.

REACTIVITY MANEUVER REQUEST FORM

NINE MILE POINT UNIT TWO

DATE _____ CYCLE EXPOSURE _____ MWD/ST

REACTIVITY MANEUVER REQUESTED

STARTUP ☐ SEQUENCE EXCHANGE ☐

PATTERN ADJUSTMENT ☐ RECIRC FLOW CHANGE ☐

RODLINE CONTROL ☐ OTHER (SPECIFY) ☐

_____

CONDITIONS NECESSARY TO PERFORM MANUEVER

_____

_____

_____

SPECIAL PRECAUTIONS

_____

_____

_____

SUBSEQUENT POWER CHANGES

_____

_____

_____

THIS FORM IS REQUIRED FOR ALL REACTIVITY CHANGES EXCEPT:

1) REACTOR SHUTDOWNS
2) CONTROL ROD MOVEMENT OR RECIRC FLOW CHANGES MADE IN ACCORDANCE WITH CORE REACTIVITY CONTROL BOOK
3) CHANGES MADE PER SORC APPROVED PROCEDURES

APPROVED FOR USE:

VALID FROM ___/___/___ THRU ___/___/___

_____ _____
REACTOR ENGINEER DATE/TIME

_____ _____
STATION SHIFT SUPERVISOR DATE/TIME