

Document Section  
**INFORMATION ONLY**  
C. R. Nuclear

REFUELING PROCEDURE

FP-401

FLORIDA POWER CORPORATION

CRYSTAL RIVER UNIT 3

REACTOR VESSEL CLOSURE HEAD REMOVAL AND REPLACEMENT

Docket # 58-302  
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REGULATORY DOCUMENT

REVIEWED BY: Plant Review Committee

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APPROVED BY: Nuclear Plant Manager

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Date 5/15/78

8003 130 735

1.0      PURPOSE

To set forth the steps required to remove, store, check the flange surfaces, install two new flange O-rings, and reinstall the reactor vessel closure head.

<u>Procedure</u>	<u>Section</u>
Head Removal	8.0
Gasket and Head Replacement	9.0

2.0      DESCRIPTION

- 2.1      The reactor vessel consists of a domed closure head, shell, and domed bottom head. The closure head bolts to a ring flange on the upper shell and carries the control rod mechanism housings, three lifting lugs, and service structure support which supports the control rod drive (CRD) equipment.
- 2.2      When ready for removal, the combined weight of the closure head, studs (which are stored on the closure head), and associated parts is about 300,000 lbs. The outside diameter of the closure head is about 200 in.
- 2.3      An arrow, pointing to the space between stud #1 and stud #60, is welded to the top of the closure head. Studs are numbered from 1 to 60 increasing in the clockwise direction as seen from above the closure head.
- 2.4      To mate the head to the vessel, three mechanical systems assure proper alignment and effective closure: alignment studs, alignment keys, and the closure stud assemblies.
- 2.5      Two metallic O-rings are used to seal the vessel at the closure head joint. System pressure is admitted to the inner O-ring. Pressure may be placed between the O-rings to test for leaks without bringing the vessel up to pressure. The O-rings are replaced before each closure.
- 2.6      A missile shield is installed above the reactor vessel service structure. This shield is made up of three pieces, all of which must be removed to provide crane access to the closure head.

3.0      REFERENCES

- 3.1      Instruction Book No. 172, B & W Reactor Vessel Instruction Manual
- 3.2      FP-402, Reactor Vessel Closure Head Stud Removal and Replacement
- 3.3      FP-403, Head Seal Leak Test
- 3.4      FP-404, Canal Seal Plate Removal and Replacement
- 3.5      MP-108, Control Rod Drive Handling
- 3.6      OP-301, Filling and Venting the RC System
- 3.7      OP-303, Draining and Nitrogen Blanketing of the RC System
- 3.8      OP-209, Plant Shutdown
- 3.9      B & W Dwg. No. 135561E; Arrangement and Details, Gaskets and Fasteners
- 3.10     B & W Dwg. No. 141000E, Arrangement Head Storage Stand
- 3.11     B & W Dwg. No. 140970E, Head and Internals Handling Fixture Assembly
- 3.12     B & W Dwg. No. 135563E, Service Structure Support and Flange
- 3.13     B & W Dwg. No. 135553E, Control Rod Drive Mechanism Housing
- 3.14     B & W Dwg. No. 135550E, Miscellaneous Closure Head Details
- 3.15     B & W Dwg. No. 99563C, Stud Support Spacer
- 3.16     B & W Dwg. No. 99564C, Stud Handling Adapter
- 3.17     B & W Dwg. No. 101988D, Castellated Nut Wrench
- 3.18     B & W Dwg. No. 165257E, Closure Head Service Structure
- 3.19     SP-358, Refueling System Interlocks
- 3.20     TG-000-20, Clean Areas and Clean Rooms
- 3.21     GAI Dwg. No. L-001-032, Plan Above Reactor Bldg. Operating Floor-Elev. 160' 0"
- 3.22     GAI Dwg. No. L-001-042, Plan Above Reactor Bldg.-Elev. 180' 0"
- 3.23     B & W Pressurized Water Reactor Technology, Volume 3, Section 12  
(This reference contains useful information and sketches.)
- 3.24     CP-115, In-Plant Equipment Clearance and Switching Orders

4.0 ENCLOSURES

Enclosure 1      Record of Small Items Monitored Near Open Reactor Vessel

5.0      LIMITS AND PRECAUTIONS

- 5.1      Work may be carried forth only when the temperature of the closure head and flange exceeds the Design Transition Temperature (DTT).
- 5.2      No welding, burning, chipping, grinding, arc strikes, inadvertent impacts, notches, grooves, or stress concentrations shall be imposed on the reactor head equipment.
- 5.3      Prevent contamination of the reactor vessel internals from any source (rags, debris, part pieces, tools, etc.). Secure tools with lanyards for use where they could drop into the reactor vessel. Arrange lights so that the breakage cannot contaminate. Weld, tape, or otherwise secure equipment parts to prevent accidental disassembly into the vessel. Maintain accountability of tools and small items. (See Enclosure 1.)
- 5.4      Do not allow crane hook to come in contact with reactor coolant.
- 5.5      Follow the general precautions set forth in FP-501, Reactor Internals Removal and Replacement.
- 5.6      Inspect the head and internals lifting fixtures, including crane, cables, and fittings before lifting the closure head.
- 5.7      Do not remove any component from the fuel transfer canal (including the two seal O-rings) which has been exposed to the reactor coolant (RC) until approval is received from the ChemRad Section.
- 5.8      When handling the reactor vessel closure joint seal O-rings, do not deform them to an extent greater than the deformation allowed during shipping.
- 5.9      Safety-lock the connecting pins on the head and internals handling fixture.
- 5.10     Only Neolube may be used as a lubricant where exposed to RC.

6.0      EQUIPMENT AND PERSONNEL REQUIREMENTS

- 6.1      Verify operability of the following reactor building services and equipment after entry is authorized by an approved Radiation Work Permit.
- a. All lighting and electrical services, including canal underwater lights.
  - b. Pneumatic Service (100 psi available)
  - c. Elevator
  - d. Phones and Intercom System
  - e. Safety Alarms and Monitors
  - f. Circulating Fans
  - g. Hoists (including polar crane)
  - h. Cooling and Ventilating Units
  - i. Emergency Hatch Air Locks
- 6.2      Check out the following equipment (after entry is authorized if the equipment is in the reactor building):
- a. Fuel Handling Bridge Cranes-  
Move out of the way from above the reactor.
  - b. Canal Seal Assembly
  - c. Control Rod Grapple
  - d. Long-handled hook and guide and wrench tools.
  - e. CRD Handling Tools
  - f. Head Storage Stand
  - g. In-core instrumentation handling equipment, including cask and replacement instruments.
  - h. Head and Internals Handling Fixture
  - i. Closure Head O-Rings (At least two sets placed on the head storage stand and checked out.)

- j. Service structure hoists with associated rigging equipment.
- 6.3 Chloride-free detergent such as Turco's DECON 4501-A or DECON 4512-A.
- 6.4 Adhesive tape suitable for use on stainless steel.
- 6.5 Plastic Sheeting, 6-mils thick, approximately 3 ft. wide (Approximately 100 square feet will be adequate.)
- 6.6 Materials and tools for repair of head insulation, if necessary.
- 6.7 Miscellaneous tools for disconnection and connection of electrical and fluid lines, removal of head insulation, removal and replacement of the head O-ring gaskets, installation of canal seal gaskets, etc.
- 6.8 Tie-lines for tools used over the reactor.
- 6.9 Two or more radiation monitors.
- 6.10 One or more inside calipers which open to one foot and one or more one foot rulers (to measure the head level).
- 6.11 Tags for identifying disconnected lines.
- 6.12 One polar crane operator, nine mechanics, and one electrician to work to this procedure. Three of the mechanics shall be capable of rigging the closure head for hoisting.
- 6.13 One copy of this procedure with a wooden pencil only.
- 6.14 Molykote-G Lubricant (manufactured by Dow Corning Corporation)
- 6.15 Tools for cleaning and smoothing the flange surfaces and O-rings.
- 6.16 Material for cleaning up any spillage of contaminated water.
- 6.17 Three-quarter inch rubber gasket stock and cement to form the seal plate gaskets.

- 6.18 Leadscrew Installation Tool (Diamond Power Specialty Corporation)
- 6.19 Service power (110 volts AC) at the closure head and the head storage stand for working lights and power tools.
- 6.20 Vacuum Lifter Tool

7.0      REQUIRED INITIAL CONDITIONS AND PLANT STATUS

- 7.1      An approved Radiation Work Permit (RWP) and an Equipment Clearance Order.
- 7.2      Missile shield slabs removed to storage location shown on GAI Dwg. No. L-001-032.
- 7.3      The RC system has been cooled, depressurized, and drained.
- 7.4      Verify that all electrical, mechanical, and instrumentation disconnects are completed.
- 7.5      Reactor vessel metal temperature above the Design Transition Temperature (DTT).
- 7.6      Head seal leak-off valve to reactor building normal sump open.

PROCEDURE

8.0 HEAD REMOVAL

Initials

NOTE: Man in charge shall initial in blank to right of each section upon completion of the step.

- 8.1 An RWP and Equipment Clearance Order have been approved and issued. \_\_\_\_\_
- 8.2 The limits and precautions of Section 5.0 have been noted. \_\_\_\_\_
- 8.3 Equipment and personnel are available as listed in Section 6.0 and checked out. \_\_\_\_\_
- 8.4 The initial conditions of Section 7.0 have been met. \_\_\_\_\_
- 8.5 Verify that the fuel transfer cover plates are removed per FP-304, Fill and Drain of the Fuel Transfer Canal. \_\_\_\_\_
- 8.6 Bring equipment into the RB. Handling equipment normally stored outside the RB is moved into the building through the personnel air locks. Although opening the equipment hatch is not usually required, it may be opened when the RC system has been cooled and depressurized to refueling shutdown conditions and the RB atmosphere has been checked for allowable radiation levels. \_\_\_\_\_
- 8.7 Disconnect electric and fluid lines from the CRD service structure in accordance with MP-108, Control Rod Drive Handling. \_\_\_\_\_

NOTE: If APSR's are to be uncoupled using the Group Power Supply, the electrical and fluid lines should remain connected until after APSR's are uncoupled.

8.8 Verify that after RC system pressure reaches 75 to 100 psi, all of the 69 CRD pressure housings have been vented per MP-108, Control Rod Drive Handling, Section 17.0.

8.9 Drain inlet and outlet headers on service structure well as the connecting spool pieces to the canal. Disconnect CRD mechanism cooling water inlet and outlet headers. Store each header spool piece on the shielding floor. Attach temporary covers to the exposed flanges using 6-mil polyethylene sheeting and adhesive tape.

NOTE: If APSR's are to be uncoupled using the Group Power Supply, the electrical and fluid lines should remain connected until after APSR's are uncoupled.

8.10 Disconnect and tag each of the 69 CRD junctions along the side of the canal in accordance with MP-108, Control Rod Drive Handling. Store the harness on the service structure platform.

NOTE: If APSR's are to be uncoupled using the Group Power Supply, the electrical and fluid lines should remain connected until after APSR's are uncoupled.

8.11 Remove clamps holding segments of thermal insulation. Lower the insulation racks (four) to the canal floor for loading. With the use of a service structure hoist, lift each insulation segment high enough to clear adjacent segments, then transfer the segment to a rack. Using the polar crane, transfer the racks back to the operating floor when full (four segments to each rack).

8.12 Lower the water level in the RC system until it reaches a level approximately two to six inches below the level of the closure flange. Reduce RC pressure to ambient.

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- 8.13 Verify that the seal gasket and seal plate have been installed between the reactor vessel flange and the fuel transfer canal per FP-404, Canal Seal Plate Removal and Replacement.
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- 8.14 Verify that each of the 69 control rod housing pressure caps have been removed per MP-108, Control Rod Drive Handling.
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- 8.15 Transfer the stud tensioners to the service structure as follows:
- 8.15.1 Pick the tensioner up with a sling attached to the polar crane.
- 8.15.2 Hoist the tensioner up over the canal and lower it down to the area around the service structure.
- 8.15.3 Attach the service structure hoist sling to the second ring on the sling and assume the load.
- 8.15.4 Detach the polar crane hook from the first sling ring.
- 8.16 Verify that each of the CRD's from the control rod assemblies has been uncoupled per MP-108, Control Rod Drive Handling.
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- NOTE: Steps 8.16, 8.17, and 8.18 may be performed in parallel.
- 8.17 Verify that the 52 in-core instrument assemblies have been withdrawn from the core and store in refueling positions per FP-701, In-Core Monitor Handling.
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- 8.18 Detension and remove studs and install alignment studs. Complete the steps set forth in Sections 8.0 and 9.0 of FP-402, Reactor Vessel Closure Head Stud Removal and Replacement.
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- 8.19 Clean the flange area. Remove all loose parts and tools from the area. From this point forward until the closure head has been replaced, monitor all small tools, parts, and other items brought to the vicinity of the reactor. Keep a written record using the format shown in Enclosure 1. Safety-tie all tools which will be used in the area over the reactor. \_\_\_\_\_
- 8.20 Remove all tools and equipment from the fuel canal area in preparation for flooding. \_\_\_\_\_
- 8.21 Attach a cover plate to the cavity flooding line flange. \_\_\_\_\_
- 8.22 Verify that the valves in the drain line from the transfer canal to the RB sump have been opened. \_\_\_\_\_
- 8.23 Hose down the canal walls and floor with demineralized water. \_\_\_\_\_
- 8.24 Verify that the valves in the drain line from the transfer canal to the building sump have been closed. \_\_\_\_\_
- 8.25 Verify that the valves in the drain line of the fuel transfer tubes have been closed. \_\_\_\_\_
- 8.26 Prepare and inspect the head and internals handling fixture and the head lifting pendants. Pin the assembly to the polar crane hook and hoist the entire assembly over the service structure. \_\_\_\_\_

NOTE: As an alternate method, the lifting pendants may each be separately attached to the lifting lugs on the closure head by following the intent of Steps 8.27, 8.28, and 8.29 for each pendant and then pinning the tripod to the pendants.

Supports for the pendants are needed on the service structure if this method is to be used. Ensure proper matching of lifting equipment to components is accomplished.

- 8.27 Match the numbered reactor vessel head lifting pendants to the corresponding lugs on the closure head.

NOTE: The pendant turnbuckles have been set for a level lift of the reactor vessel head, locked in place with locking nuts, and scribed upon initial installation. Subsequent operations will be simplified by carefully assuring that components of the lifting gear are lined up the same way as upon initial installation.

- 8.28 Open the pendant access doors on the walkway at the top of the service structure. Assure that each pendant is suspended over its matching head lifting lugs. Lower the fixture and pendants. Manually guide each pendant through the walkway access doors. Match the pendant eyes with the head lifting lugs.

- 8.29 Pin each pendant to its head lifting lug and remove the slack from the rigging. Inspect each pendant and fitting to assure that all are secure and locked. Verify that the alignment studs are installed as specified in FP-402, Reactor Vessel Closure Head Stud Removal and Replacement, and are secure.

- 8.30 Inspect the entire head and service structure to verify that all connections between the head and building have been broken and cleared. Assure

that there are no obstructions to the required path from the reactor vessel to the closure head storage stand. Assure that no loose gear, tools, equipment, parts, or debris are present on the closure head.

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8.31 Verify that two or more survey instruments have been placed on the canal floor at either side of the closure head by the ChemRad Section.

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8.32 Notify all personnel in the RB that the closure head is being removed and temporarily evacuate all personnel not involved in this activity. Assure that the lift path to the head storage stand is clear.

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- CAUTION:
- a. Lift the closure head by the lifting lugs only.
  - b. Carefully avoid damage to the sensitive sealing surfaces of the closure head and vessel flanges.
  - c. While lifting, keep the closure head level within 0.02 in. per foot, 5/16 of an inch across the entire diameter.
  - d. Assure that the lifting rig does not ride or bind against the service support structure or other attachments of the closure head.
  - e. Safety-lock all connecting pins.

8.33 Hoist enough to place a heavy load on the hoist equipment without moving the closure head. Recheck the hoist assemblies.

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8.34 Hoist the head from the vessel, keeping the head level within 5/16 of an inch across its entire diameter. While lifting the head off, maintain contact with the Control Center for monitoring of nuclear instruments. Visually verify that control rods have been disconnected. When the head has been lifted about one to two inches, check the head level by measuring at four locations on the flange (approximately 90° separation).

8.35 If not within level limits, lower the head. Readjust the hoist equipment so the head will be level when rehoisted.

WARNING: Keep all personnel clear of the area under the head while lifting.

8.36 Assure adequate measures have been taken to prevent contamination of floor or structures.

8.37 Move the head to the head storage stand. Make sure the stand is clear of all loose material and debris. Move the head over the head storage stand. Visually verify that the head and stand are concentric, that there is one inch of diametrical clearance between the inside vertical surface of the head and the storage stand gussets, and that there are two inches of lead-in on the gussets. Lower the head to rest on the stand. Carefully avoid damaging the flange sealing surface.

NOTE: As an alternate method, the lifting pendants may be left attached to the closure head lifting lugs and uncoupled from the tripod. The tripod is then hoisted away from the head. Supports for the lifting pendants are needed on the service structure if this method is to be used.

- 8.38 Slack the hoist, unpin the pendants from the lifting head lugs, and hoist the fixture and the pendants away from the head.
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- 8.39 With the approval of the ChemRad Section, use a 5X magnifying glass and carefully inspect the O-ring seating and sealing surfaces of the reactor vessel. Hand-dress any minor scratches to a smooth finish by lapping or using Scotch-Brite. The most minute scratch or blemish on either sealing surface may cause a leak. Clean the sealing surface as necessary using a chloride-free detergent.
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NOTE: The man in charge shall initial in the blank to the right of the section after completion of the step.

9.1 After a survey and approval is given by the ChemRad Section, loosen the O-ring retaining clips on the underside of the closure head flange. Slide the clips toward the center of the head and free the O-ring. Cut into pieces and remove both of the old seal O-rings. B & W Dwg. #135561E and the B & W Reactor Vessel Instruction Manual apply.

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9.2 With the use of a 5X magnifying glass, carefully inspect the O-ring seating and sealing surfaces of the closure head. Hand-dress any minor scratches to a smooth finish by lapping or using a fine emery cloth. The most minute scratch or blemish on the sealing surface may cause a leak. Clean the sealing surface, as necessary, using a chloride-free detergent.

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9.3 Lift the inner O-ring and hold it against the sealing surface while sliding the clips into the perforations in the O-ring. Tighten the retaining screws.

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NOTE: Soft surface clamps may be used to hold the O-ring in place.

9.4 Lift the outer O-ring and hold it against the sealing surface while sliding the clips into the perforations in the O-ring. Tighten the retaining screws.

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- 9.5 Inspect and service the CRD's.
- 9.6 As necessary, depending on disposition of the hoist equipment, prepare and inspect the head and internals handling fixture and the head lifting pendants. Pin the assembly to the polar crane hook and hoist the entire assembly over the service structure.
- 9.7 Match the numbered reactor vessel head lifting pendants to the corresponding lugs on the closure head. See "Notes" of Steps 8.26 and 8.37 for alternate method.
- 9.8 Open the pendant access doors on the walkway at the top of the service structure. Assure that each pendant is suspended over its matching head lifting lugs. Lower the fixture and pendants. Manually guide each pendant through the walkway access doors. Match the pendant eyes with the head lifting lugs.
- 9.9 Pin each pendant to its head lifting lug and remove the slack from the rigging. Inspect each pendant and fitting to assure that all are secure and locked.
- 9.10 Assure that there are no obstructions to the required path from the closure head storage stand to the reactor vessel.
- 9.11 Assure that no loose gear, tools, equipment, parts, or debris are present on the closure head.
- 9.12 Assure that the reactor vessel is free of loose gear, tools, equipment, parts, or debris, and the reactor is ready to receive the closure head. Assure that

the alignment studs are properly installed and secure. Drain the canal (per FP-304, Fill and Drain of the Fuel Transfer Canal) to the level specified by the ChemRad Section.

9.13 Hoist enough to place a heavy load on the hoist equipment without moving the closure head. Recheck the hoist assemblies.

9.14 Inform all personnel in the RB that the reactor vessel closure head is being moved and hoist the head from the stand. Keep all personnel clear of area under the head.

9.15 Move the head to a point approximately one foot above the alignment studs. Align holes "15" and "45" with the alignment studs.

9.16 Inch the head down until the alignment studs are within the stud holes. Continue lowering to where the flange surfaces are separated by about six inches.

- 9.17 Check the head level by measuring flange separation approximately every 90° around the flange. If out of level by more than 5/16 of an inch, raise the head above the alignment studs and readjust the head level. Lower the head to rest on the stand. Readjust the hoist equipment so the head will be level when rehoisted.
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- 9.18 After head is found to be level within 5/16 of an inch, inch the head down until the head lifting pendants are slack. Remove the pendants and handling fixtures.
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- 9.19 Install and load studs in accordance with FP-402, Reactor Vessel Closure Head Stud Removal and Replacement.
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- 9.20 Hose down the walls and floor of the transfer canal and bridge masts and grapples.
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- 9.21 Remove the blind flange from the cavity flooding line flang..
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- 9.22 Reinstall the transfer tube cover plates.
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- 9.23 Couple the 69 CRD's to the control rods using the rod coupling tool following the procedure outlined for uncoupling in reverse. (See Step 8.16.)
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- 9.24 Install the closure head thermal insulation as follows:
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- 9.24.1 Lower each segment down into the canal and position it near the reactor closure head with the building crane, then connect all segments with clamping devices. Transfer the load to one of the stud hoists.

- 9.24.2 Lower the segment with the stud hoist and lock the segments together after all have been replaced.
- 9.25 Replace the CRD cooling water lines as follows: \_\_\_\_\_
- 9.25.1 Remove the protective covers from the exposed flanges.
- 9.25.2 Hoist the manifold sections up and lower them into place after replacing gaskets for each flange.
- 9.25.3 Bolt up each flange and remove the lifting slings.
- 9.26 Install the 69 control rod housing pressure caps per Section 17.0 of MP-108, Control Rod Drive Handling. \_\_\_\_\_
- 9.26.1 (deleted)
- 9.26.2 (deleted)
- 9.26.3 (deleted)
- 9.27 Verify that the RC system has been filled as per OP-301, Filling and Venting of the RC System. \_\_\_\_\_
- 9.28 Close all vent valves. \_\_\_\_\_
- 9.29 Connect all electrical service leads between the junction boxes and the 69 CRD's. \_\_\_\_\_
- 9.30 Leak-check the CRD mechanisms, system vents, head O-ring gaskets, and in-core instrument lines. \_\_\_\_\_
- 9.31 Remove all tools, fixtures, ladders, supplies, identification tags, and like items from the canal area. \_\_\_\_\_
- 9.32 Replace the missile shield slabs above the reactor vessel using the building crane. \_\_\_\_\_

9.33 (deleted)

9.34 Inspect service and clean all tools, fixtures, and equipment. Return these items to normal storage. Wrap in plastic film if necessary. \_\_\_\_\_

9.35 Notify the Operations Section that the reactor is ready for return to normal operation. \_\_\_\_\_

9.36 Verify that the blanks on one copy of this procedure, Sections 8.0 and 9.0, have all been initialed by the individuals responsible for completing the steps noted at the left. Verify that Enclosure 1 has been completed and is attached. Note any problems or recommendations on the blank sheet opposite the problem step. Send the initialed copy (with the completed Enclosure 1) to the Maintenance Superintendent. \_\_\_\_\_

