CONSOLE INSTALLATION, CHECK OUT AND TEST PLAN

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CONSOLE INSTALLATION, CHECK OUT AND TEST PLAN

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PHASE I: INSTALLATION PREPARATION

1. ___ Document Installation as Appropriate -- Pictures - Audio/Video

2. ___ Training Program Continued
   a. ___ Electronics Classes
      ___ Practical Electronic Techniques
   b. ___ Computer Classes
      ___ Common Applications
      ___ Introduction to Programming
      ___ Introduction to C language
   c. ___ Conduct a Comprehensive Operator Requalification Training Program

3. ___ Conduct comprehensive and thorough review of license (R-84), Technical Specifications, Operational Procedures, Safety Analysis Report, and any other associated reactor documentation and compare to the new console specifications to insure consistency and compatibility with NRC requirements and regulations.

4. ___ Coordinate with Logistics for console delivery (See Phase II).

5. ___ Coordinate Installation Schedule with Logistics, Radiation Safety and AFRRI Department Heads. Send DF to AFRRI and post in AFRRI Bulletin.
   ___ SAF
   ___ Rad Physics
   ___ AFRRI Department Heads

6. ___ Label facility interlock system wires and junction boxes (ie JB-1A, JB-1B and JB-2).

7. ___ Label all remaining wires in the control room (ie Console and Auxiliary Console).

8. ___ Prepare locations for the new console prior to installation and for the old console following it's removal.

9. ___ Modify the wall and mount wall supports. AFRRI will mount the NM1000 and translators using GA supplied materials. (See GA Phase IV - New Console Installation, Attachment 2, #8).

10. ___ Decide on the physical layout of the control room.
    - ___ New Console
    - ___ 2 New Auxiliary Consoles
    - ___ 2 New Computer Work Stations

11. ___ Determine Plan for removing Old Console and Installing New
    - ___ Insure Safety Channel Instrumentation Monitoring during console change out
    - ___ Control Room Lighting (Consider repainting room)
    - ___ Cable Access to Console
    - ___ Wire Trays
    - ___ Get floor stripped, cleaned, waxed, retiled (coordinate with logistics)
    - ___ Decide on what to do with the hole in the floor from the old console
    - ___ Incorporate the wiring document - <u>See Attachment 1</u> (Describe the power cable routing and connections to the console and to the Rod Drives)

12. ___ Determine which wires must be rerun to the new console and which wires will be run to the D.C.
    - ___ Radiation Safety Alarm/Interlock System (JB-2)
        - ___ R1
        - ___ Primary CAM
        - ___ Low H_2O Level
    - ___ Facility Interlock System (JB-2)
    - ___ Reactivity Computer
    - ___ Auxiliary Console
        - ___ Radiation Monitors
        - ___ H_2O Conductivity
        - ___ Fuel Temperature
        - ___ H_2O Temperature
    - ___ Reactor Core Dolly Drive System
    - ___ Core Position Indication Systems
    - ___ Core Extreme Travel Limit indicators (green lights for exposure rooms)
    - ___ Pb Shield Door Movement
    - ___ Intercom System
    - ___ Reactor Door-Open Buttons
    - ___ TV Monitor Switches
    - ___ Exposure Room Open Indicators
    - ___ Time Delays

13. ___ Determine destinations of all equipment in the old auxiliary consoles (ie New Auxiliary Consoles or elsewhere).

14. ___ Insure that adequate installation materials (cables, connectors, wires, electronic equipment, tools, and supplies) are available.

15. ___ Check Calibration of Required Calibration Instrumentation

16. ___ Produce Neutron Monitoring, Safety Start-up, Modified Shutdown, and Modified Weekly Checklist Procedures.
    ___ Instruct Staff on use.

17. ___ Produce Proposed Modified Reactor Operational Procedures.

18. ___ <u>Plan for and Complete the boom modification.</u>
    ___ Coordinate with Logistics
    ___ Determine type, number and size of wires to be run in the new boom and in the saddlebags on the new boom.
    ___ Determine new boom design - consult with GA
    ___ Boom modifications performed by GA (See Phase VI)
    ___ Ground boom to provide electromagnetic interference shielding
    ___ Insure ease of boom movement
    ___ Install sheathing as required to prevent sharp edges from stressing the wires and cables

19. ___ <u>Plan for and Modify Rod Drive Housing</u>
    a. ___ Coordinate with Logistics
    b. ___ Prepare for New Drives
        ___ Consider installing a temporary "catch all" under the Rod Drive Housing
        ___ Housing removed
        ___ Drives removed, packaged and shipped to GA (See Phase V)
        ___ Plate modified/removed
        ___ Replace plate
        ___ Receive new drives (See Phase II)
        ___ Install new drives
        ___ Install new housing
            ___ Design and Install a better mechanism (ie wires) to draw the boom from side to side.

20. ___ Remove all excess wires and equipment.

21. ___ GA will complete a full system hardware/software checkout prior to shipment (This Checkout Procedure will include Attachment 3 plus a checkout of the NM1000, NPP1000, NP1000 and the new Stepping Motor Rod Drives).

22. ___ AFRRI will conduct an operational checkout of the new GA console installed at the GA Mark 1 reactor prior to shipment of the AFRRI console.

23. ___ Prepare extra Ion Chambers and housing for parallel console hook-up.

24. ___ Prepare extensions for parallel thermocouple hook-up to the new console -- checkout extra thermocouples in the in-core instrumented fuel elements at power (if necessary add additional instrumented elements).

25. ___ Organize Shop, Work Benches and tool cabinets.

PHASE II: GA EQUIPMENT DELIVERY TO AFRRI

1. ___ Document Equipment Deliveries as Appropriate -- Pictures - Audio/Video (Table 1 GA Deliverable Items).

2. ___ GA will ship new NP1000 and NPP1000 units prior to console delivery.

3. ___ Coordinate with Logistics [illegible] console delivery -- Arrange for Receiving s[illegible]
   a. ___ Fork Lift (Greg [illegible]
   b. ___ Arrival Date
   c. ___ Route into Bldg [illegible] to control room (draw map, determine minim[illegible] [illegible]ensions and points, and ant[illegible] [illegible]ms)
   d. ___ To clear route o[illegible] [illegible]l and loading dock) and clear ou[illegible] items [illegible]n the hall
   e. ___ Number, size and weight of items arriving
   f. ___ Coordinate with MILCON the day, route and K-Lot Control
   g. ___ Insure that logistics has sufficient moving equipment available on the delivery date including handtrucks and carts to move the crates from the dock to the reactor
   h. ___ Insure crane has been load tested and appropriate rigging materials are on-hand

4. ___ Insure that the console movement route through AFRRI is clear on the delivery date (Check route 1 week prior and the day before arrival).

5. ___ Insure that the entire reactor staff is available on the delivery date.

6. ___ Insure that the required console storage space is ready.

7. ___ Console Delivery Day
   ___ Final check with security.
   ___ Final check with MILCON.
   ___ Required materials (forklift, handtrucks, rope) in parking lot and ready to go.
   ___ Follow established routes to deliver console.

TABLE 1 GA DELIVERABLE ITEMS

GA Shipments

1. Core Monitoring Instrumentation: NP1000 and NPP1000 units.

2. NM1000 Wall Mounts, Stepping Motor Translators and Mounts, and Boom Modification Equipment.

3. The Reactor Instrumentation and Control System.

   - 5 wooden crates; full size, 18 wheel semi-truck.

ITEM	CRATE SIZE (IN) W	X H	X DEPTH	WEIGHT (LB)	QTY
CONSOLE	90	52	48	700	1
DAC	29	68	40	400	1
AUXILIARY CABINETS	29	68	76	300	1
NM-1000	32	33	30	250	1
CABLES AND MISCELLANEOUS	29	68	40	400	1

4. New Stepping Motor Rod Drives (3).

5. Additional rebuilt Fission Chamber.

6. Pipe for Fission Chamber installation near Core.

7. Stand for new Rod Drives.

8. DAC Maintenance CRT Monitor and Keyboard.

9. Additional AT compatible computer with CRT Video Monitor and Keyboard.

10. Contract Spare Parts Shipment (have on-hand for console installation and checkout).

PHASE III: NEW/OLD CONSOLE PARALLEL HOOK-UP

1. ___ Unpack new console equipment (See GA PHASE IV - New Console Installation, Attachment 2). Insure that all equipment is present and in good condition.

2. ___ Install CSC on reactor deck in temporary location.

3. ___ Install DAC on reactor deck in permanent location.

4. ___ Add extra Ion Chamber(s) and extra Fission Chamber to Core.

5. ___ Install new chambers (Pulse: Neutron Ion Chamber and Cherenkov).

6. ___ Mount NM1000 and translators.
   ___ GA to provide mounts and instructions.
   ___ AFRRI to perform the job.

7. ___ Install/Hook-up NM-1000.

8. ___ Hook-up chambers to NM-1000 and DAC.

9. ___ Hook-up additional fuel temperature channels (thermocouples) to DAC.

10. ___ Connect CSC to DAC using GA supplied cables.

11. ___ Setup new Stepping Motor Rod Drives in temporary mount (GA supplied stand) on reactor deck.

12. ___ Hook-up Rod Drives to DAC using GA supplied cables.

13. ___ Hook-up extra water temperature probe to DAC.

14. ___ Route GA supplied Facility Interlock jumper extension from the control room to the new console in the reactor room.

15. ___ Route GA supplied Transient Rod Drive jumper extension from the old console to the DAC.

16. ___ Install "Low Water Level" test switch at the DAC.

17. ___ Hook-up AC power to the CSC and the DAC.

PHASE IV: NEW CONSOLE CRITICAL SYSTEM TEST AND CHECKOUT

In this phase the new console will be checked-out. It will monitor the core and have the ability to drive the new rod drives which have been mounted on a temporary stand in the reactor control room. The old console will be used to control the reactor (no changes will have been made to the old control console at this point) while the new console follows the power and fuel temperature.

1. ___ Perform GA supplied system software checkout (See Attachment 3).

2. ___ Check ability of the new console to follow the power and fuel temperature.

3. ___ Check the ability to drive the new rod drives. Verify CRT display as well as the operation of the microswitches.

4. ___ Check all SCRAMS and RWPs.

5. ___ Checkout the calibration sequences (Automatic and manual).

6. ___ Checkout the Facility Interlocks and Microswitches.

7. ___ Test Transient Rod Drive
   - ___ Decouple all of the rod drives from the old console.
   - ___ Hook-up Transient rod drive cable to GA supplied jumper running to the DAC.
   - ___ Check the ability to drive the rod.
   - ___ Checkout the functioning of the Transient Rod Air System (including zero power pulse).

8. ___ Test the Manual, Automatic, Square Wave and Pulse control modes.

9. ___ Test the ability to drive the core and follow the core positioning as well as the ability to open and close the lead shield doors.

10. ___ Perform reactor operator training on the new console.

PHASE V: OLD CONSOLE REMOVAL

1. ___ Document Old Console Removal as Appropriate -- Pictures - Audio/Video

2. ___ Implement Plan for removing Old Console and Installing New
   - ___ Insure Safety Channel Instrumentation Monitoring during console change out
   - ___ Control Room Layout
   - ___ Control Room Lighting (Consider repainting room)
   - ___ Cable Access to Console
   - ___ Wire Trays
   - ___ Get floor stripped, cleaned, waxed, retiled (coordinate with logistics)
   - ___ Decide on what to do with the hole in the floor from the old console
   - ___ Incorporate the wiring document - See Attachment 1 (Describe the power cable routing and connections to the console and to the Rod Drives)

3. ___ Verify Page Four, Calculate number of Pulses, and Verify Fuel Element Records are correct to date.

   ___ Total power generated to date:_____Kw-hrs.

   ___ Total number of pulses to date:_____.

   ___ Fuel element records correct to date.

4. ___ Core positioned at 833 (doors opened) or desired position.

5. ___ Deck plates positioned on tracks over reactor tank.

6. ___ Communication to control room established.

7. ___ Set up temporary core monitoring detectors with NP1000 and NPP1000.

8. ___ Perform full Startup Checklist.

9. ___ Perform Excess Reactivity Measurement. Record in Operations Logbook and in Core Physics Logbook.

10. ___ Calculate Shutdown Margin. Record in Operations Logbook and in Core Physics Logbook.

11. ___ Remove and ship rod drives to GA for modifications (Note: Reg, Safe and Shim Drives will be shipped after Phase VIII, the Transient Drive will be shipped immediately).

___ Transient drive air supply secured. (Turn off Regulator, bleed line and close valve. Insure pressure is applied to lead shield door bearings.)

___ Accumulator tank bled.

___ Accumulator tank valve open.

___ Console power OFF (at regulator.)

___ Uncouple rod drive cables from back of console.

___ Standard rod drives labeled.

___ Top plate/structure of control rod drive housing removed.

___ SHIM rod drive removed and prepared for shipment.

___ SAF rod drive removed and prepared for shipment.

___ REG rod drive removed and prepared for shipment.

___ Insure connecting rods secured within core shroud.

___ Transient rod disconnected from housing (remove tapered pin.) NOTE: Pin on trans rod:
a. Black on big end
b. Number of turns

___ TRANS rod drive removed and prepared for shipment.

12. ___ Remove enough Fuel (~$6.00 - B & D ring elements) from Core to insure Shutdown and to Prevent criticality (Subcritical Condition).

___ Reapply console power (insure neutron sensitivity.)

___ Monitor neutron channel readouts during fuel or control rod movement. Enter fuel and rod movements into logbook. Update Fuel Log and Core Diagram.

___ Fuel handling tool operation verified using standard fuel element.

___ Instrumented fuel element connectors labeled (only if removed).

___ Move any extra elements desired to temporary storage.

___ Insure that shutdown margin would be at least $0.50 if most reactive control rod was fully removed. Record in Core Physics Log and Reactor Operations Logbook.

13. ___ Core instrumentation - Mark all cable connections.

14. ___ Disconnect power to the old console (obtain description of the power cable routing and connections - See Attachment 1).

15. ___ Remove old console wiring.
    a. ___ Label and Remove Excess wires from old console
        ___ Timer Cables
        ___ Rod Drive Cables
        ___ Operational Channel
        ___ Fuel Temperature Channels
        ___ Safety High Flux Channels
        ___ Pulse Channel
    b. ___ Label, Remove and Set Aside wires to be reused
        ___ Intercom Box
        ___ Low H_2O Level
        ___ H_2O Temperature
        ___ Facility Interlocks
        ___ Reactivity Computer
        ___ Core Position indicator
        ___ Core Dolly Movement
        ___ Pb Shield Door Movement
        ___ Reactor (Offices) Door Buttons
        ___ TV Monitor Switches
        ___ Exposure Room Open Indicators
        ___ Time Delays

16. ___ Remove electronic equipment and wires from the old Auxiliary Console - Insure that essential equipment remains functional (RAMS, Fuel Temperature, Conductivity, H_2O Activity, Ventilation Flow Chart, AR-41 Chart, Reactor Ventilation Damper Controls, Reactivity Computer, TV Controls, Core Positioning Indicator, etc.). Investigate possibility of installing new Victoreen RAMs.

17. ___ Label appropriate wire in Junction Box #2. Label and disconnect Junction Boxes #1A and #1B.

18. ___ Remove old Console and Auxiliary Racks.

19. ___ Run wires needed to connect the facility status systems to the DAC (coordinate with GA).

20. ___ Store all old equipment in predesignated locations.

21. ___ Modify/Replace Rod Drive Housing Base Plate.

PHASE VI: NEW CONSOLE INSTALLATION

1. ___ Document Installation as Appropriate
   - ___ Pictures - Audio/Video
   - ___ Update Maintenance Manuals - Facility Drawings
   - ___ Begin Historical Report
   - ___ Begin New Console Operational History/Malfunction Data Base

2. ___ Modify Boom.
   - ___ Boom modifications performed by GA.
   - ___ Ground boom to provide electromagnetic interference shielding
   - ___ Insure ease of boom movement
   - ___ Install sheathing as required to prevent sharp edges from stressing the wires and cables

3. ___ Move new console to control room.

4. ___ Install new chambers (Pulse: Neutron Ion Chamber and Cherenkov). If not done previously.

5. ___ Recable Boom (See GA Phase IV - New Console Installation, Attachment 2, # 10-31).

6. ___ Install the console and new auxiliary consoles.

7. ___ Install/Hook-up NM-1000, NPP-1000, NP-1000, Fuel Temperature Channels.

8. ___ Rehook-up Wires from old Console to New.

9. ___ Hook-up facility interlock system to the CSC/DAC.

10. ___ Hook-up Facility Status Channels to the DAC
    - ___ RAMS, CAMS, SGM, SPM
    - ___ Water Temperature
    - ___ Water Conductivity

11. ___ Receive Rebuilt Transient Rod Drive from GA.

12. ___ Hook-up New Rod Drives and align Rods.

    - ___ Reinstall TRANS drive.
    - ___ TRANS rod connecting rod threaded into piston assembly.
    - ___ Tapered pin through TRANS connecting rod

replaced.

___ TRANS rod anvil replaced.

___ Rod drives inspected and installed.

___ Insure each rod has proper alignment in core.

___ TRANS rod air accumulator tank valve closed.

___ Air line filter checked and housing cleaned.

___ TRANS air rod line alignment checked.

___ Air compressor between 80 and 100 psig.

___ Air supply valves opened.

___ TRANS rod air pressure (reactor room) set at 80 psig.

___ Lead shielding door bearing pressure set at 9 psig.

13. ___ Connect power to the new console (obtain description of the power cable routing and connections -- See Attachment 1).
- Power Connections
  - 20 amp breaker for rod drives - from MCC
  - Connection to console and DAC

14. ___ Perform Rod Drop Measurements.

SHIM _____ msec REG _____ msec

SAFE _____ msec TRANS _____ msec

15. ___ Finish rod drive housing modification (this step may be delayed if necessary).

16. ___ Determine necessity for Fission Chamber cable shielding from noise on old fission chamber

PHASE VII: SYSTEM CALIBRATION AND CHECKOUT

1. ___ Document as Appropriate
   - ___ Pictures - Audio/Video
   - ___ Continue Updating Maintenance Manuals & Facility Drawings
   - ___ Continue Historical Report
   - ___ Continue New Console Operational History and Operational Malfunction Data Base

2. ___ Verify ability to drive Core Dolly and the operation of both Core Position Indicators.

3. ___ Verify ability to open/close Pb Shield Doors and verify the new console indicators and prep area status board.

4. ___ Verify Operation of Radiation Safety Alarm System
   - ___ R1
   - ___ Primary CAM
   - ___ Low H_2O Level

5. ___ Perform Modified Start-up Checklist

6. ___ With Fuel Removed (~$6.00) -- Insure AFRRI Licensed Senior Reactor Operator On-Console at all times.

   a. ___ Complete (thorough) System Software Checkout (See Attachment 3). Routine system functions performed by programmable code will be executed and the results verified; programmable code functional checks will include system and subsystem components.

   b. ___ Complete (thorough) System Hardware/Operational Calibration and Checkout
      - ___ Insure Safety Channels Operable
      - ___ Calibrate (3) Fuel Temperature Channels
      - ___ Calibrate Fuel temperature recorder
      - ___ Insure Operational Channel Operable -- Use Am-Be source.
      - ___ Insure Pulse Channel and Detectors Operable
      - ___ Checkout SCRAMS, Interlocks, and RWP's
      - ___ Perform Functional Check of New Rod Drives
        - ___ Individual rod drive indicators ON.
        - ___ Key in console and reactor reset.
        - ___ SHIM, SAFE and REG rod microswitches adjusted & total travel measured.
          - ___ SHIM rod _____ in travel.
          - ___ SAFE rod _____ in travel.

___ REG rod _____ in travel.
___ TRANS rod coupled.
___ TRANS rod microswitches adjusted & total travel measured.
___ TRANS rod _____ in travel, including coupling.
___ Check Full range of Rod Drive motion and response
___ Check Limit Switches
___ Check Rod Position Indicators
___ Perform functional "fire" check of the Transient Rod (Zero Power Pulse)
___ Checkout Facility Interlocks using attached procedure -- See Attachment 4 (must be performed under ROS supervision.)
___ Test Operational Modes
___ Manual
___ Pulse
___ Automatic
___ Square Wave
___ Test All Operational Characteristics and Interfacing of the New System
___ Historical Recording and Playback
___ Facility Status interface with CSC/DAC
___ Peripheral Equipment
___ Recorders
___ Printers
___ Plotters

7. ___ Return Some Fuel to the Core (<500KW) - update logbooks and core diagram.

a. ___ Full Start-up checklist completed.
___ Bring reactor critical to indicated 15 watts for operational check.
___ Conduct an Excess Reactivity Measurement.
b. ___ Continue Operational Calibration and Checkout.
___ Verify Safety Channels Operable
___ Verify Operational Channel Operable
___ Verify Pulse Channel and Detectors Operable
___ Calibrate
___ Operational Channel (Thermal Power Calibration)
___ Water Temperature
___ Checkout SCRAMS, Interlocks, and RWP's
___ Test Operational Modes
___ Manual
___ Automatic
___ Square Wave

8. ___ Return All Fuel to the Core (1 MW) - update logbooks and core diagram.

a. ___ Conduct an Excess Reactivity Measurement.

b. ___ Conduct a full power calibration.

___ Thermal power calibrations performed at Pos 567, 231, 903.

___ Power monitoring detectors adjusted.

___ Safety Channels - % Power

___ Pulse Channels

___ Checkout SCRAMS, Interlocks, and RWP's

___ Compare LED Bargraph readouts with CRT data

___ Test Operational Modes

___ Manual

___ Pulse

___ Automatic

___ Square Wave

9. ___ Perform Maintenance Diagnostics Training and Checks

Calibration will consist of specifications and measurements of parameters at key test points for analog and digital systems/subsystems, and the identification and execution of tests for the digital systems/subsystems. Test points for analog specifications will include parameters and tolerances for voltages, frequencies, and waveforms critical for calibration and trouble shooting. Test programs for digital execution will include faulty component identification and functions tested and will include testing of the following: CPU instructions, RAM memory, values stored in ROM, communications and function of all I/O ports.

PHASE VIII: OPERATIONAL TESTS AND OPERATOR TRAINING

1. ___ Document as Appropriate
   - ___ Pictures - Audio/Video
   - ___ Post Installation Training Program
     - ___ System Update/Changes, Training by GA Staff at AFRRI
     - ___ Facility Specific Interfacing by GA Staff at AFRRI
     - ___ Reactor Operator "On Console" Training
     - ___ Additional Maintenance Training
   - ___ Continue Updating Maintenance Manuals & Facility Drawings
   - ___ Rewrite Console Calibration Section of Annual Shutdown Checklist
   - ___ Continue Historical Report
   - ___ Continue New Console Operational History and Operational Malfunction Data Base
   - ___ Verify Proposed Reactor Operational Procedures

2. ___ Perform Rod Calibrations

   - ___ Reg, Safe, Shim, Trans Rods calibrated at Pos 567.
   - ___ Check ER1 and ER2 to insure that no shielding materials are in front of the tank projection.
   - ___ Reg, Safe, Shim, Trans Rods calibrated at Pos 833.
   - ___ Reg, Safe, Shim, Trans Rods calibrated at Pos 903.
   - ___ Reg, Safe, Shim, Trans Rods calibrated at Pos 231.
   - ___ Integral rod worth curves prepared.

3. ___ Perform Reactivity Worth Measurements

   - ___ K-excess measured at Pos 833 is $_____.
   - ___ K-excess measured at Pos 903 is $_____.
   - ___ K-excess measured at Pos 567 is $_____.
   - ___ K-excess measured at Pos 231 is $_____.
   - ___ Reflector coefficient calculated relative to Pos 567.

     Pos 903:_____ Pos 833:_____ Pos 231:_____

   - ___ Shutdown margin at position 567 is $_____.
   - ___ Measure worth of an element from each ring.

___ Reactor power coefficient measured at 100KW and 1MW.

100KW _____ 1MW _____
(complete power coefficient curve)

___ Reflector Coefficient and Reactor Parameter charts prepared for Reactor Operating Instruction Notebook, Volume I.

4. ___ Conduct thorough operational testing of all modes (Manual, Auto, Pulse, Square Wave). As a minimum, perform the following operations:

   a. ___ Manual and Auto Mode Reactor Operations
      ___ 15 W (Test Manual SCRAM)
      ___ 42.5 KW (Check Timer SCRAM)
      ___ 500 KW (Test Emergency Stop)
      ___ 975 KW (Open Pb Shield Doors)
      ___ 1 MW (Manual SCRAM)
   b. ___ In Auto Mode test the ability to change power while in Auto Mode. Also, test various Rod Banking Configurations and Rod Servoing Configurations. Test 1 MW at Pos. 903.
   c. ___ Perform One Operation in each Core Position.
   d. ___ Square Wave Operations
      ___ 42.5 KW
      ___ 500 KW
      ___ 750 KW
   e. ___ Pulse Mode (Critical and Subcritical)
      ___ $1.00 at .5 sec pulse timer
      ___ $1.50 "
      ___ $2.00 "
      ___ $3.00 "
      ___ $3.25 "
      ___ $3.50 "
      ___ $1.00 at 15 sec pulse timer
      ___ $1.50 "

5. ___ Conduct 80 hours of various operations while training reactor operators (this includes the Rod Calibrations, Reactivity Worth Measurements, and Operational Mode Testing).
   ___ Perform Foil Dosimetry.

6. ___ Conduct an RRFSC Operational Review

7. ___ Conduct final review of license (R-84), Technical Specifications, Operational Procedures, Safety Analysis Report, and any other associated reactor documentation in light of the new console specifications to insure consistency and compatibility with NRC requirements and regulations.

PHASE IX: FINAL ACCEPTANCE

1. ___ Documentation - Alt
   a. ___ Documentation File - Alt
   b. ___ Pictures - Audio/Video - Felty
   c. ___ Installation and Checkout Plan - Hodgdon
   d. ___ Training Program - Ting
   e. ___ Maintenance Manuals - Facility Drawings - Reed
   f. ___ Safety Analysis Report - Munno
   g. ___ Historical Report - Ting
   h. ___ New Console Operational History/Malfunction Data Base - Talkington

2. ___ Conduct Reactor Operator Qualification Examinations.

3. ___ Prepare for RRFSC Acceptance and NRC review

4. ___ Safety Committee Approval - Moore/ Hodgdon
   a. ___ Installation, Checkout and Test Plan
   b. ___ Training Program
   c. ___ 10 CFR 50.59 Facility Modification Safety Evaluation
   d. ___ Proposed New (modified) AFRRI TRIGA Reactor Facility Safety Analysis Report
   e. ___ New Reactor Operational Procedures.

5. ___ Conduct final acceptance of the console with GA (formal).

6. ___ NRC Review
   a. ___ Annual or Special Report
   b. ___ 10 CFR 50.59 Facility Modification Safety Evaluation
   c. ___ Proposed New (modified) AFRRI TRIGA Reactor Facility Safety Analysis Report
   d. ___ New Reactor Operational Procedures.

CONSOLE WIRE MAP

ATTACHMENT 1

CONSOLE WIRE MAP

Prior to beginning the removal of console wires, the back panels will be removed from the rear of the console.

I. VARIOUS WIRES AND CABLES:

Rerouting of the bulk water temperature cable:

The bulk water temperature cable which currently runs from the east side of the reactor pool to the present console will be rerouted to the DAC, which will be on the reactor deck.
The bulk water temperature is read out on a meter on the current console. The temperature probe will be wired to the DAC upon installation of the new console.

Removal of the intercom box and cables:

The intercom will be removed from the old console and installed to enable use while the new console is being installed. This cable is marked with a cable tie.

Removal of the low water level and timer cable:

The low water level and timer cable is connected to the right hand drawer assembly by a cannon plug, this cable is marked by a wire tie. There is no marking on the right hand drawer. This cable is connected to the J-2 junction box. Care will be exercised, the timer and its associated cable will be removed while the low water alarm will remain in place to maintain the lobby alarm. The low water level alarm will have to be wired into the DAC as well as the Junction Box 2.

Removal of the power cables in the rear of the console:

There are 2 power cables which shall be removed, one is in flexible conduit and is connected to the console voltage regulator located in room 3181. The other is connected to the rear of the swing out door in the rear of the console. Power will be supplied to the CSC and DAC from the existing voltage regulator this will require paralleling the power line to go to the two locations. Another power requirment is for the rod drive translators. This will require a 20 amp, 115 volt circuit through EMT from the motor control center or a new location to the translators located in the Reactor Room.

Other wires and cables:

The wires to the monitor (TV) switch on the old console will be removed and hooked to the monitor (TV) switch on the new console.
Currently there are 2 limit switches, one for full into ER#1 and one for full into ER#2, these are wired to the auxiliary console. For the new console these will be wired to the DAC.

II FUEL TEMPERATURE AND SAFETY CHANNELS:

Removal of fuel temp and safety cables:

The fuel temperature and safety channels are direct cable runs from the console to the reactor core dolly.

The following cables will be removed:

	CONSOLE	CORE DOLLY
Safety 1 signal	J-203	Safety chamber 1
Safety 1 high voltage	J-202	Safety chamber 1
Safety 2 signal	J-403	Safety chamber 2
Safety 2 high voltage	J-404	Safety chamber 2
Fuel temp 1	TB-6 5a6	Fuel temp block
Fuel temp 2	TB-7 5a6	Fuel temp block

Installation of the fuel temperature and safety cables:

The following cables will be installed:

CABLE	FROM	TO	HOW
NP - 1000	Core Dolly	DAC	Thru Boom
NPP - 1000	Core Dolly	DAC	Thru Boom
Fuel Temp #1	Core Dolly	DAC	Thru Room
Fuel Temp #1	Core Dolly	DAC	Thru Boom

III OPERATIONAL AND PULSE CHANNELS:

Removal of cables wired to the Pre-Amp and Pulse chambers:

These cables are direct run cables to the pulse chambers and the pre amp to the fission chamber.

The following cables will be removed:

	Console	Core Dolly
Pre-Amp high voltage	J-216	Pre-Amp
Pre-Amp test	J-211	Pre-Amp
Pre-Amp signal	J-209	Pre-Amp
Pulse high voltage	J-408	No connection
Pulse signal	J-409	No connection
Pulse 3 high voltage	J-411	Gamma chamber
Pulse 3 signal	J-410	Gamma chamber

Replacement of operational and pulse channels:

These cables will be replaced as follows:

CABLE	FROM	TO	HOW
Fission Chamber	Core Dolly	NM-1000	Thru Boom
NPP - 1000	Core Dolly	DAC	Thru Boom

IV ROD DRIVE CABLES:

Removal of rod drive cables:

For whatever reason there is some equipment wired using the same cables as the current rod drives. This equipment will be required to be disconnected prior to removal of the current rod drive cables and then reconnected by separate cable runs. This equipment is as follows:

Core daily speaker Core Position Pot	These 2 are wired from the console to JB-1A to JB-1B to a labeled cannon plug in the rod drive housing. The Core daily speaker will be wired to the intercom cables via a separate cable run. The core position pot will be wired to the DAC.

Remove the following wires and junction boxes. These should be removed intact if possible, beginning from the back of the current console.

	Console	Junction Box	Junction Box	Drive Housing
Shim rod drive	J-502	JB-1A	JB-1B	Labeled Cannon Plug
Safe rod drive	J-503	JB-1A	JB-1B	Labeled Cannon Plug
Reg rod drive	J-505	JB-1A	JB-1B	Labeled Cannon Plug
Trans rod drive	J-506	JB-1A	JB-1B	Labeled Cannon Plug

These cables will be pulled from the reactor console into the reactor room, intact if possible. The next step will be to remove the rod drive wires from the boom. This will be accomplished by unplugging the rod drives feeding these wires through the boom and into the reactor deck cable race ways. At this point the rest of the cables for the rod drives, as well as the two junction boxes should be able to be removed. These cables and junction boxes should be labled and placed in a known location.

Replacement of the Rod Drive Cables:

New rod drives will be installed as part of the console upgrade. The new cables will be installed as follows:

DRIVE	FROM	TO	HOW
Transient Rod Drive	Drive Housing	DAC	Thru Trays Outside of Boom
Shim Rod Drive	Drive Housing	Translators	Thru Trays Outside of Boom
Reg Rod Drive	Drive Housing	Translators	Thru Trays Outside of Boom
Safe Rod Drives	Drive Housing	Translators	Thru Trays Outside of Boom

V FACILITY INTERLOCK SYSTEM (Overview)

The facility interlock system prevents accidental exposure of an individual, and prevents the inadvertant movement of the core into the lead shield doors. The facility interlock system is hard wired into the reactor console from junction box J-2 to connector P-1 near the terminal strips, bottom rear of the console. At the present time disconnecting of P-1, will cause a loss of magnet and air and prevent raising any control rod.

The power for all indicating lights on the console is supplied from the power supply PS501 located on the swing out door on the rear of the console.

Magnet and air power for the reactor console are supplied by PS502 located on the swing out door on the rear of the reactor console. Power to this power supply is routed through the key switch and the power on switch on the console. Power to this power supply is also routed through the facility interlock system and associated time delay relays.

FACILITY INTERLOCK SYSTEM

The facility interlock system is currently interfaced to the reactor console via a cable which runs from Junction Box J-2 to Plug P-1 in the center portion of the bottom of the console. Following is a wire to

Wire description of this cable:

Connector P-1	Junction Box 2
1	35
2	1
3	4
4	2
5	3
6	27
7	28
8	25
9	26
10	21
11	22
12	TB A-7
13	16
14	TB B-3 to 8
15	TB C-1 to 7
16	TB A-1
17	29
18	30
19	31
20	32
21	TB B-1
22	NC
23	8
24	17
25	10
26	23
27	NC
28	24
29	TB B-2
30	NC
31	NC
32	NC

The wiring for the facility interlock system is as follows.

On plug P-1, the following pairs of contacts will give the indicated results:

Light	P-1	J-2
Shield door closed light	15-10	TB-C - 21
Shield door open light	15-11	TB-C - 22
Core position 2 light	15-12	TB-C - TB-A7
Time delay light	15-13	TB-C - 16
Emergency stop light	15-24	TB-C - 10
Operate light	15-25	TB-C - 17
Shield door stop light	15-26	TB-C - 23
Core position 1 light	15-27	TB-C -
Core position 3 light	15-28	TB-C - 24
ER-1 light	16-21	TB-A1 - TB-B1
ER-2 light	16-23	TB-A1 - 8
Core daily towards position 1	17-18	29-30
Core daily towards position 3	19-20	31-32
Shield door to open switch	06-07	27-28
Shield door to close switch	08-09	25-26

Reactor operate permissive	81	35
Reactor operate key switch	2,3,4,5	1,4,2,3

The shield door stop switch is wired in such a way as to interrupt the current which holds the shield door open or shield door closed switches. When the shield door stop button is pressed, opening or closing action is interrupted.

The facility interlock system will require a 12 volt power supply to power the lights which will be on the right side of the reactor console. This power supply will be wired to provide a positive potential and a return in series with the appropriate indicator lamps through the facility interlock system.

There will be scrams and interlock connections made through the DAC from the reactor relay control panel. The appropriate relays and connections will be mapped out in advance to facilitate connections.

GA [illegible] NEW CONSOLE INSTALLATION

ATTACHMENT 2

PHASE IV

New Console Installation

A. Introduction

Cabling between the new console (CSC) and the reactor has been greatly reduced over the old console scheme. This is one of the many advantages of this new system utilizing digital communications between the console and the field assembly called the data acquisition computer or DAC. The DAC, located near the reactor, is where the majority of the reactor cables are now terminated. The DAC then communicates with the CSC digitally over one twisted shielded pair.

B. Equipment Location

1. Unpack the CSC and with wheels still attached, position in place. _____

2. Remove wheel carriage and bolt console to floor, if required. _____

3. Unpack the DAC and locate in the reactor hall. Wheels will not be detached. _____

4. Before unpacking the NM-1000 microprocessor and preamp assemblies, have the following GA supplied parts ready

   a) 9/16' open end wrench _____
   b) Eight 9/16' x 1/2' x 1-1/2' hex head bolts _____
   c) Eight 1/2' nuts w/spring _____
   d) Eight 1/2' flat washers _____
   e) Eight 1/2' lock washers _____
   f) Small ladder or stool about 1 or 2 ft high _____

5. Two people are required to install each of the NM-1000 assembl (microprocessor & preamp). _____

6. Unpack the NM-1000 microprocessor unit and install it on the pre-installed unistrut framework nearest the DAC. _____

7. Unpack the NM-1000 preamp unit and install it on the pre-installed unistrut framework next to the microprocessor unit. _____

8. Before unpacking the three translater assembly, have the following GA supplied parts ready:

   a) 9/16' open end wrench _____
   b) Four 9/16' x 1/2' x 1-1/2' hex head bolts _____
   c) Four 1/2' nuts w/spring _____

d) Four 1/2' flat washers _____
e) Four 1/2' lock washers _____
f) Small ladder or stool about 1 or 2 ft high _____

9. Unpack the three translator assembly and install it on the pre-installed unistrut frame near the boom._____

10. Boom Recabling - The following cables are part of the effort:

Item	Cable Qty.	Location on Boom
1) Translator	3	Outside
2) Rod Drive	4	Outside
3) Fuel Temp	3	Inside
4) NM-1000	1 (w/shield)	Inside
5) NP-1000	2	Inside
6) NPP-1000	5	Inside
7) Core Dolly Pwr	1	Outside
8) Outlet water temp	1	Inside
9) CAM HOSE	1	Outside
10) Criticality Detectors	4	Outside
11) Dolly tracker	1	Inside
12) Diffuser Pump PWR	1	Outside
13) Transient Rod AIR	1	Outside

The boom will be used to shield all sensitive circuits by placing them inside. 120 VAC and noisy circuit will be keep outside the boom. Note location in the above list. _____

11. Since the majority of the cables have been terminated on the reactor side of the boom, it will be necessary to handle all "inside" boom cables at their un-terminated end for pulling. Be sure all cables are tagged on each end. After securing with nylon reinforced tape to a pull wire, start the wire through the reactor side of the boom gently pulling the cable handle. Pull and feed the handle until about five feet is completely through the boom. _____

12. Remove pull wire and unwrap all tape. _____

13. Now each cable can be fed and pulled to its destination as required. _____

14. Position each cable without terminating any wires._____

15. Carefully check and double check that each cable has sufficient length to reach its final connection point allowing for movement of the core as well as cable dressing. _____

16. Tie down all "inside" cables while taking the effort to keep them separated from other cabling that may

generate noise, i.e., EMI, RFI, etc. Tie down the entire cable using cable ties where necessary. _____

17. Put in place the "outside" cables listed in item 10 taking care to keep the boom cabling organized and neat. _____

18. Repeat steps 13, 14, & 15. _____

19. If the rod drives are in position, terminate all wires "inside & outside" associated with the boom on both ends. Otherwise terminate all wires but the rod drives using APPENDIX B, DAC WIRE LIST as reference. _____

20. Connect 120VAC which has been run from a MCC/20 amp breaker to the circuit breaker box for the three translators. Use conduit for the connection and Leave power OFF. _____

21. Connect 120 VAC which has been run from the control room to the DAC circuit breaker. Leave all power OFF. _____

22. Run eight bar graph cables between the CSC (bar-graphs) and the NM-1000 and DAC. Leave cables neat and organized. _____

23. The NM-1000 provides input for the Log Power and period. _____

24. The DAC provides input for the percent power safety channels, fuel temperatures, NV and NVT. Refer to APPENDIX B, DAC & CSC WIRE LISTS as reference. _____

25. Run the two conductor 18 gauge cable for connection of the magnet loop between the DAC and CSC. Keep cable neat and separated for easy identification. Refer to APPENDIX B, DAC & CSC wire lists. _____

26. Install the two communication networks between the DAC and CSC. Keep cables neat and organized. _____

27. Connect the CSC facility interface connector to the AFRRI facility connector. _____

28. Connect 120 VAC power from the CSC switched power strip to the DAC power cable. See item 21. _____

29. Connect 120 VAC power from the control room main to the CSC power breaker. _____

30. When the rod drives are in position, make the appropriate connector connections. _____

31. The stepping motor rods, i.e., regulation, safety and shin, have two connectors each and the transient rod has only one. _____

GENERAL ATOMICS: TRAC-1000 INSTRUMENTATION SYSTEM ACCEPTANCE TEST PROCEDURE

ATTACHMENT 3

General Atomics

Title: TRAC-1000 INSTRUMENTATION SYSTEM ACCEPTANCE TEST PROCEDURE			
Doc. No. GATR-E-02	Issue B	Date 4/12/88	Page i of ii

QAL III

ISSUE SUMMARY

Issue	Date	Prepared by	Approved by	Purpose of Issue/Sections Changed
A	3/23/88	Gerard Logan	W K Hyde	Original issue
B	4/12/88	Gerard Logan	W K Hyde	Revised after testing

Notations in this column indicate where changes have been made

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1.0 SYSTEM STARTUP

For brevity, the following shorthand notations will be used.

CSC = Control System Computer
DAC = Data Acquisition Computer
STW = Status Window
WW = Warning Window
SCW = SCRAM Window and
AW = Reactor Display Annunciator Window

1) Turn on power to the DAC and the CSC. The DAC and the CSC should begin their boot-up sequences. You should see the memory test count up to "1152 KB OK" on the console video display. Next, you should see the Bootstrap 10 second timeout. Do not type anything here, let the Bootstrap timeout. Do not type anything there, let the Bootstrap timeout. Next, you should see the CSC Operating System (IC-DOS) bootup. This begins with a number of lines of dianostic printout, followed with "IC-DOS - VER X.X", followed by Action Instruments Copyright notice, and "Remote Server Process Started".

   If an abnormal shutdown of the system preceeded this startup, the operating system will perform a file system consistency check consisting of 5 phases (phases 2 through 5 are repeated) and then will reboot itself beginning with the memory test. Do not enter any keystrokes in response to questions during the file system consistency check sequence, it will proceed automatically.

   Following bootup of the operating system, auto bootup of the GA application code will begin. The database will be booted and, if successful, the printout "Database bootup was successful!" will be displayed. Next, the network is tested and if OK the printout "Network Test Cycle #X: Network looks OK" will be displayed. The CSC will next attempt to establish communications with the DAC and instruct the DAC to begin its bootup sequence. During the DAC bootup, the CSC draws the Reactor display on the high resolution CSC screen and displays a 90 second countdown timeout of the DAC bootup. If the DAC boots up successfully (approx 40 seconds), the timeout display is replaced by the STW display.

2) The Reactor Animation Display should contain the following information:

   a) Bar Graph Displays:
      * Multi-range Linear Power
      * % Log Power ---> corresponds to LOG PWR hardwired bar display, on left side of console.
      * Period ---> corresponds to DPM hardwired bar display
      * % Power (3 graphs) ---> corresponds to two "%" hardwired bar displays

Notations in this column indicate where changes have been made

b) Temperature Readout Boxes:
   * Fuel #1
   * Fuel #2 } correspond to "^{o}C" hardwired bar displays

c) Rod Position Readout Boxes:
   * Transient Rod
   * Regular Rod
   * Shim Rod (one for each shim)

d) AW Box (Error/Warning Message Box):
   * Read/Black Rectangular box in top right corner.
   * All SCRAM messages and system error messages appear in this box

e) System Information Box:
   * Date
   * Time
   * Mode
   * System
   * Demand Power

f) Reactor Graphic Display:
   * Graphic for each reactor rod
   * Graphic for each rod drive
   * Graphic for each rod magnet (air for transient rod)

3) The Status Window display should contain the following information:

a) Coolant water inlet temperature
b) Coolant water outlet temperature
c) Coolant water pool temperature
d) Primary coolant flow
e) Secondary coolant flow
f) Primary coolant conductivity
g) Thermal power
h) Beam port #1 status
i) Beam port #2 status
j) Beam port #3 status
k) Beam port #4 status
l) Reactor room door status
m) Thermal door status
n) Exposure room door status
o) Radiation Area Monitor #1
p) Radiation Area Monitor #2
q) Radiation Area Monitor #3
r) Radiation Area Monitor #4
s) Radiation Area Monitor #5
t) Radiation Area Monitor #6
u) Current pulse number
v) System error number

Notations in this column indicate where changes have been made

4) There are three windows of display information on the left-hand video display: STW, WW, SCW. You should be able to rotate through the windows by pressing the Spacebar.

5) Turn the Magnet Power switch to the RSET position. The system should beep and remain in the SCRAM mode. The message "SCRAM - No Operator" should appear in the AW and the SCW.

6) Press the Acknowledge (ACK) button. The SCRAM message should be cleared.

7) Press the Pretest switch on the Mode Control panel. The system will go through the Prestart Checks sequence.

8) Once the Prestart Checks have been completed successfully, the system will return to the STW display.

9) Press the F5 key on the keyboard to access the operator log-on menu. Select menu item 1, Operator Log In. Type in an invalid password (such as "AAAAAA"). The system should respond with "Invalid Password . . . Permission Denied!".

10) Log on the system, using a valid password. Try logging on immediately a second time. You should get the message "*** Warning: Operator already on the system ***".

11) Exit from the log-in menu screen. The system will return to the STW display.

12) Turn the Magnet Power switch to the RSET position. The system will enter the Steady-State (Manual) mode.

13) Press the F2 key on the keyboard. The contents of the Status Window (STW) should print out on the system printer.

2.0 REDUNDANT NETWORK

1) Assure buoth networks (boards, cables and terminators) are installed in the CSC and the DAC.

2) With both the CSC and DAC power off, power up the CSC. Observe that the CSC memory test and operating system boot up properly. Refer to the System Startup Acceptance Test Procedures. Verify that during the application bootup sequence, the CSC bootup fails the network test and displays the message "Network Test Cycle #X: Network looks dead". Verify the test number increments every 20 seconds indicating the test is being repeated.

3) Power up the DAC. Allow sufficient time for the DAC to complete its memory test, boot its operating system, and start its application bootup

Notations in this column indicate where changes have been made

sequence (3 minutes max). At this point the CSC network test cycle should complete successfully indicated by the message "Network Test cycle #N: Network loks OK".

4) Verify the CSC completes its boot by observing the Reactor and STW screens being displayed.

5) Verify that none of the following network failure messages appear in the AW, WW or SCW:

   a) Hi IC-NET Comm Fault
   b) Lo IC-NET Comm Fault
   c) SCRAM - NET Fault, Please Reboot

6) Verify the network is operating by changing some DAC input such as reactor room door status and observing the change on the STW or Reactor display.

7) Remove the terminator plug from the CSC High Network board. The terminator is accessed from the rear of the CSC control console computer (or expansion chassis). Verify that a "Hi IC-NET Comm Fault" is generated in the AW and the WW.

8) Verify that the network continues to update the CSC even though the "Hi" network is inoperable.

9) Restore the terminator to the CSC high network board and ACK the error condition. Verify the error messages disappear from both the AW and the WW.

10) Remove the terminator plug from the CSC Low Network board. Verify that a "Lo IC-NET Comm Fault" is generated in the AW and the WW.

11) Verify that the network continues to update the CSC even though the "Lo" network is inoperable.

12) Restore the terminator to the CSC low network board and ACK the error condition. Verify the error messages disappear from both the AW and the WW.

13) Place the system in Steady State (Manual) mode and remove the terminator plug from both the CSC High and Low Network boards. Verify the following:

   a) A "Hi IC-NET Comm Fault" message is queued in the AW.
   b) A "Lo IC-NET Comm Fault" message is queued in the AW.
   c) A "SCRAM - NET Fault, Please Reboot" message is queued in the AW.
   d) A "Hi IC-NET Comm Fault" message is displayed in the WW.
   e) A "Lo IC-NET Comm Fault" message is displayed in the WW.
   f) A "SCRAM - NET Fault, Please Reboot" message is displayed in the SCW.

Notations in this column indicate where changes have been made

g) The Reactor display mode has changed to SCRAMMED.
h) The "MAN" pushbutton lite has extinguished.
i) The reactor has been SCRAMMED.
j) SCRAM "DATA BASE TIME OUT" queued in the AW.
k) SCRAM "DATA BASE TIME OUT" queued in the SCRAM W.

14) Restore both terminator plugs to the CSC network boards and reboot both the CSC and DAC. Verify that the system successfully reboots and the network is totally operational as outlined above.

3.0 SCRAM MODE

1) Clear all SCRAM and Warning messages and place the system into the Steady-State Operate (Manual) mode.

2) Simulate a Percent Power #2 Hi SCRAM condition to the DAC by using the scram test switches. Verify this causes:

   a) The message Percent Power #2 to appear in the AW and the WW.

3) Repeat steps (1) and (2) for Percent Power #2 H.V., Percent Power #3 Hi, and Percent Power #3 H.V.

4) Repeat step (1). Disconnect the serial communications cable from the NM-1000. Verify this causes:

   a) The message "NM1000 Comm Flt" to appear in the AW and the WW.

5) Repeat step (1). Disconnect Fuel Temp #1 TC from the DAC input. Momentarily connect in voltage source equal to what the TC would generate at 500°C. Verify this causes:

   a) The message "SCRAM" - Fuel Temp #1 Hi" to appear in the AW and the SCW.
   b) The reactor to be SCRAMMED.
   c) The reactor display to be SCRAMMED.
   d) The MAN pushbutton lite to be extinguished.

6) Repeat step (5) for Fuel Temp #2 TC.

7) Repeat step (1). Momentarily disconnect AC power from the NPP-1000. Verify this causes:

   a) The message "SCRAM - NPP-1000 HV Lo" to appear in the AW and the SCW.
   b) The reactor to be SCRAMMED.
   c) The reactor display to be SCRAMMED.
   d) The MAN pushbutton lite to be extinguished.

8) Repeat step (1). Repeat (2).

Notations in this column indicate where changes have been made

a) The message "SCRAM - Pulse Power Hi" to appear in the AW and the SCW.
b) The reactor to be SCRAMMED.
c) The reactor display to be SCRAMMED.
d) The MAN pushbutton lite to be extinguished.

9) Repeat step (1). Momentarily jumper the DAC "Pool Water Lo Lo" in[illegible]. Verify this causes:

a) The message "SCRAM - Pool Water Lo" to appear in the AW and the SCW.
b) The reactor to be SCRAMMED.
c) The reactor display to be SCRAMMED.
d) The MAN pushbutton lite to be extinguished.

10) Repeat step (1). Momentarily disconnect power from the CSC DIS064 Digital Scanner board: Wait for at least 10 seconds. Verify this causes:

a) The message "SCRAM - CSC Watchdog Timeout" to appear in the AW and the SCW.
b) The reactor to be SCRAMMED.
c) The reactor display to be SCRAMMED.
d) The MAN pushbutton lite to be extinguished.
e) The message, "SCRAM-CSC DIS064 Timeout" to appear in the SCW.

11) Repeat step (1) for the DAC DIS064 board.

12) Repeat step (1). At the DAC, switch to display window 1 by entering ALT-1 on the keyboard. (This test assumes a diagnostic keyboard and monitor are installed in the DAC.) The DAC prompt "DAC #" should be visible. Enter the commend "PS" followed by a "return". The DAC operating system should list the current process table. Enter the command "kill -9 (scanner PID)" where the scanner PID is obtained from the process table. This should kill the scanner process and trigger the DAC watchdogs. Verify the following:

a) The message "SCRAM - DAC Data Base Timeout" to appear in the AW and the SCW.
b) The reactor to be SCRAMMED.
c) The reactor display to be SCRAMMED.
d) The MAN pushbutton lite to be extinguished.

13. Re-boot.

Notations in this column indicate where changes have been made

4.0 STEADY-STATE MODE

4.1 Entering the Steady-State Mode

The steady-state mode is entered from the SCRAM mod eby switching the "MAGNET POWER" key switch from its "ON" position to its "RSET" position and then back to the "ON" position. All SCRAM conditions must be cleared and an operator logged in.

1) Clear all SCRAM conditions and acknowledge any SCRAM or warning messages in the AW by pressing the "ACK" button.

2) Operate the "MAGNET POWER" key switch from "ON" to "RSET" to "ON". The message "SCRAM - No Operator" should appear in the AW and the SCW and the Control Console should beep indicating an invalid operation has been attempted.

3) Acknowledge the SCRAM message by pressing the "ACK" button. The "SCRAM - No Operator" message should be cleared from both the AW and the SCW.

4) Initiate the operator login sequence by pressing the "F5" function key. The "Reactor Operator Log On/Off Utility:" menu should appear.

5) Select item 1, "Operator Log In", by pressing the "1" key. The prompt "Please enter your password --->" should appear below the menu.

6) Enter the password "AAAA". The message "Invalid Password . . . Permission Denied!" should momentarily appear.

7) Repeat step (6) and enter the password "ASDFGH". The message "Accepted - Welcome to the TRIGA Control System" should momentarily appear and then the entire screen replaced with the STW.

8) Repeat steps (4) and (5) and verify the message "***Warning: Operator already on the system ***" momentarily appears below the menu.

9) Exit the Login menu by selecting item 3, Exit, on the menu by pressing the "3" key. The STW should reappear.

10) Press the "MANUAL SCRAM" button. The message "SCRAM - MANUAL" should appear in the AW and the SCW. Do not acknowledge the error condition.

11) Attempt to invoke the Steady-State mode by operating the "MAGNET POWER" key switch from "ON" to "RSET" to "ON". The "SCRAM" mode should be re-entered due to the unacknowledged SCRAM condition.

12) Acknowledge the SCRAM condition and again operate the "MAGNET POWER" key switch. This time the Steady-State (Manual) mode should be invoked. The Steady-State mode will be indicated by the "Man" pushbutton lite coming on, the Reactor Display indicating "Steady-State" and Magnet

Notations in this column indicate where changes have been made

Power being applied to the rod magnets indicated on the Reactor Display by the Magnet Power being applied to the rod magnets indicated on the Reactor Display by the Magnet Power indicator boxes below the animated rod drives turning yellow. The Air Supply to the Transient rod drive will not be applied by entering the steady-state mode so its air applied box below its animated rod drive will remain black.

4.2 Exiting the Steady State Mode

The Steady-State mode will be exited when:

a) any SCRAM condition occurs,
b) the Auto mode is invoked,
c) the Square Wave mode is invoked,
d) or the Pulse mode is invoked.

Consult the SCRAM, Auto, Square Wave and Pulse mode Acceptance Test Procedures for these items. Sections 5.0, 6.0 and 7.0, respectively.

5.0 AUTO MODE

5.1 Entering the Auto Mode

The auto mode is manually entered, after selecting which rods (reg, safety, shim) or combination of rods are to be servoed, from the Steady-State mode by pressing the "AUTO" mode button or automatically by successfully completing a Square Wave ramp up sequence.

1) Re-boot.

2) Attempt to invoke the auto mode by pressing the "AUTO" mode pushbutton. Verify that the system does not change modes and the Control Console beeps once indicating an invalid operation is being attempted.

3) Log in, reset any SCRAMS, and turn the MAGNET power key switch to the RESET position. Repeat (2).

4) Invoke the Steady-State mode by pressing the "MAN" pushbutton. The "MAN" mode pushbutton lite should now be lit and the Reactor display indicating the Steady-State mode. In addition, the Magnet Power indicator boxes at the bottom of each rod drive mechanism should be yellow.

5) Manually move the Reg, Safety and Shim rods off the bottom to their 50% withdrawn position. Select which rods or combination of rods with the reg rod that are to be servoed. The Transient rod may be left at the bottom. Set the "Demand Power" thumbwheel switches to match the current power being produced by the reactor and invoke the auto mode by pressing the "AUTO" mode pushbutton. The "AUTO" mode lite should come on and the "MAN" lite go off. In addition, the Reactor display should indicate the auto mode.

Notations in this column indicate where changes have been made

5.2 Exiting the Auto Mode

The system will exit the Auto mode if:

a) The Steady-State mode is selected.
b) any rod is SCRAMMED.
c) or any SCRAM condition.

1) In the auto mode, invoke the Steady-State mode by pressing the "MAN" pushbutton. The "MAN" mode lite should come on and the "AUTO" lite go off. In addition, the Reactor display should indicate the Steady-State mode.

2) Move the Reg Rod Drive Mechanism to its fully inserted position with the remaining rods and thumbwheels positioned per item (5) above. Invoke the auto mode. The system should stay in the AUTO Mode.

3) Position the safety rod to its 10% withdrawn position and the Shim and the Reg rod at their 50% withdrawn position and invoke the auto mode. Manually move the Shim to the bottom. The system should stay in the Auto mode.

4) Repeat step (6) for each rod.

5) Position the Safety to its 90% withdrawn position and the Shim and Reg rod at their 50% withdrawn position and invoke the auto mode. Manually move the Safety to the top. The system should stay in the auto mode.

6) Repeat step (5) for each rod.

7) In the auto mode, press the "MANUAL SCRAM" button. The system should immediately change to the SCRAM mode and all mode lites will go out.

5.3 Operation Within the Auto Mode

The Auto Mode automatically controls the reactor power in accordance with the Demand Power set into the "Demand Power" thumbwheel switches. Control is accomplished by an algorithm controlling the position and speed of the servoed rods and by an up/down/stop algorithm for the non-servoed rods.

If the reactor power is at some value above or below the demand power and the auto mode is invoked, the auto mode algorithms will move the servoed rods to bring reactor power equal to the demand power setting.

The servoed rods are always under computer control in the auto mode. The non-servoed rods however are under manual control.

1) Test the ability to servo any combination of standard control rod drives.

Notations in this column indicate where changes have been made

2) Verify auto mode capability to bring reactor up to power on a 5-second period.

3) Verify rods servo from 0% to 100% with no up and down limits on any of the rods.

4) Verify demand power setting above and below power level and verify ability of Auto Mode to Control the Reactor while changing power.

5) Perform long run (20 minutes) and observe Auto Mode Drift. Verify ability to maintain power to within +/- 1.0 percent.

6) Verify system response while switching between Auto mode and Steady-State mode under constant and varying Power conditions.

7) Verify individual rod scramming in Auto mode.

8) Fire the transient rod and manually change its position. Observe the movement of the servoed rods to compensate for the power change. Balance the power (rod) profile of the reactor by manually adjusting the positions of the safety, shim and the transient rod. Keep the servoed rods within their 0% to 100% boundary during the manual adjustments and finalize its position at the 50% point for optimum control.

6.0 SQUARE WAVE MODE

6.1 Entering the Square Wave Ready Mode

1) While the system is in SCRAM mode, press the "SQUARE WAVE" button on the control console. You should hear a beep; the system should remain in SCRAM mode.

2) Place the system into AUTO mode. Press the "SQUARE WAVE" button. You should hear a beep; the system should remain in AUTO mode.

3) Place the system in PULSE mode. Press the "SQUARE WAVE" button. You should hear a beep; the system should remain in PULSE mode.

4) Place the system in MANUAL mode and raise the reactor power above 1 KW. Press the "SQUARE WAVE" button. You should hear a beep and the warning message "Power must be <1 KW!" should appear in the AW and the WW. The system should remain in MANUAL mode.

5) Lower the reactor power below 1 KW and acknowledge the warning message by pressing the ACK button. The warning message on the AW and the WW should disappear.

Notations in this column indicate where changes have been made

6) Press the "AIR" button on the control console. If the transient rod air supply was on, it will turn off and the transient rod will fall to the bottom of the reactor core. The rod drive will then wind down automatically to its bottom-most position.

7) Press the "FIRE" button to apply air pressure to the transient rod. Press the "SQUARE WAVE" button. You should hear a beep and the warning message "Trans Rod Air must be off!" should appear in the AW and the WW. The system will remain in MANUAL mode.

8) Remove the air supply to the transient rod by pressing the "AIR" button and acknowledge the warning message by pressing the ACK button. The warning message on the AW and the WW will disappear.

9) Introduce the large negative Period to the reactor by first running a shim rod to its top position and then SCRAMMING it. While the large negative period is occurring, press the "SQUARE WAVE" button. You should hear a beep and the warning message "DPM must be < +/-1!" should appear in the AW and the WW. The system will remain in MANUAL mode.

10) Acknowledge the warning message by pressing the ACK button. The warning message on the AW and the WW will disappear.

11) You have just completed testing the various interlocks which prevent entry into SQUARE WAVE mode. Now prepare the system to enter the SQUARE WAVE mode by creating the following conditions:

    a) System is in the MANUAL mode.
    b) Reactor power is less than 1 KW.
    c) The rate of change of reactor power is less than 1 DPM.
    d) The transient rod air pressure is off and the transient rod is all the way down.

12) Press the "SQUARE WAVE" button. You should see the mode change to "SQUARE - READY" on the reactor animation display and the SQUARE WAVE button will illuminate on the control console.

6.2 Entering the Square Wave Ramp-Up Mode

1) Set the target reactor power level in the thumbwheel switch on the control console. The reactor power will not change yet.

2) Position the transient rod drive mechanism manually using the transient rod UP and DOWN buttons on the control console.

3) Press the FIRE button. The system will now enter the "SQUARE - RAMP UP" mode. If reactor power reaches the demand level (as set in the thumbwheel switch), the system will transfer to AUTO mode. If not, the system will return to MANUAL mode. You should also see the error message "Power Level Not Reached Timeout" on the video display.

Notations in this column indicate where changes have been made

7.0 PULSE MODE

The Pulse Ready Mode is initiated from the Steady-State mode by pressing the "PULSE" mode button and entering a pulse ID string. The pulse is initiated from the Pulse Ready mode by pressing the "FIRE" button. 5000 power readings are taken during the 1/2 second pulse period. Peak fuel temperature readings are acquired during the next 4 seconds and then calculations are made from the pulse data and presented on the standard resolution screen.

A high resolution plot of the pulse data may be displayed in the SCRAM mode.

7.1 Entering the Pulse Ready Mode

1) While the system is in SCRAM mode, press the "PULSE" button on the control console. You should hear a beep; the system should remain in SCRAM mode.

2) Place the system into AUTO mode. Press the "PULSE" button. You should hear a beep; the system should remain in AUTO mode.

3) Place the system in SQUARE WAVE READY mode. Press the "PULSE" button. You should hear a beep; the system should remain in SQUARE WAVE READY mode.

4) Place the system in MANUAL mode and raise the reactor power above 1 KW. Press the "PULSE" button. You should hear a beep and the warning message "Power must be < 1 KW!" should appear in the AW and the WW. The system should remain in MANUAL mode.

5) Lower the reactor power below 1 KW and acknowledge the warning message by pressing the ACK button. The warning message on the AW and the WW should disappear.

6) Press the "AIR" button on the control console. If the transient rod air supply was on, it will turn off and the transient rod will fall to the bottom of the reactor core. The rod drive will then wind down automatically to its bottom-most position.

7) Press the "FIRE" button to turn on the air pressure to the transient rod. Press the "PULSE" button. You should hear a beep and the warning message "Trans Rod Air must be off!" should appear in the AW and the WW. The system should remain in MANUAL mode.

8) Remove the air supply to the transient rod by pressing the "AIR" button and acknowledge the warning message by pressing the ACK button. The warning message on the AW and the WW should disappear.

Notations in this column indicate where changes have been made

9) Introduce a large negative Period to the reactor by first running a shim rod to its top position and then SCRAMMING it. While the large negative period is occurring, press the "PULSE" button. You should hear a beep and the warning message "DPM must be < +/-1!" should appear in the AW and the WW. The system should remain in MANUAL mode.

10) Acknowledge the warning message by pressing the ACK button. The warning message on the AW and the WW should disappear.

11) You have just completed testing the various interlocks which prevent entry into PULSE READY mode. Now prepare the system to enter the PULSE READY mode by creating the following conditions:

    a) System is in the MANUAL mode.
    b) Reactor power is less than 1 kW.
    c) The rate of change of reactor power is less than 1 DPM.
    d) The transient rod air pressure is off and the transient rod is all the way down.

12) Press the "PULSE" button. You should see the mode change to "PULSE - READY" on the reactor animation display and the PULSE button should illuminate on the control console. The STW should be replaced by the message "Enter Pulse ID String --> ".

13) Enter a string of characters to identify the pulse followed by a carriage return. The STW should reappear.

7.2 Entering the Pulse Data Acquisition Mode

1) Position the transient rod drive mechanism manually using the transient rod UP and DOWN buttons on the control console to the desired reactivity level.

2) Press the FIRE button. The system will now enter the "PULSE" mode and the message "** Acquiring Pulse Data ... Please Wait **" will replace the STW display. The transient rod air supply should turn on and the transient rod should drive up until stopped by the drive mechanism and a reactor pulse should be produced. The air supply should turn off after 1 second however the system data acquisition phase should continue for another 4 or 5 seconds.

3) At the end of the data acquisition phase, the mode should switch to the STEADY-STATE mode with the MAN lite on and the PULSE lite off. The WAIT message should be replaced with an Alphanumeric Pulse Data display on the standard resolution screen. Verify the following pulse data items for correctness:

    a) Identification String.
    b) Pulse Number.
    c) Time Stamp.

Notations in this column indicate where changes have been made

d) Peak Fuel Temperature.
e) Peak Power.
f) Energy.
g) Width at Half Power.
h) Reactivity.
i) Minimum Period.

4) Hit the SPACEBAR key on the keyboard. The STW display should be restored.

7.3 Displaying Alphanumeric Pulse Data

1) Press the "F3" key on the keyboard. A "Pulse Select Menu" should replace the STW with 10 pulse selections available.

2) Select the pulse just acquired by its associated ID string. The Alphanumeric Pulse Data display for the pulse should be re-displayed.

3) Hit the SPACEBAR key on the keyboard. The STW display should be restored.

4) Repeat steps (1) thru (3) for other pulses.

7.4 Graphic Pulse Data Display

1) Manually SCRAM the reactor by pressing the manual SCRAM button. The MAN lite should extinguish and the mode should change to SCRAM. Clear the SCRAM message by pressing the ACK button.

2) Press the "F3" key on the keyboard. The "Pulse Select Menu" should replace the STW display.

3) Select the pulse just acquired above. A Graphic or Non Graphic Pulse Display menu should replace the Pulse Select menu.

4) Select the Graphic Display by entering "1" on the keyboard. The Graphic or Non Graphic menu should be replaced by a "Pulse Scaling Data" screen.

5) For now, select the default settings by answering "N" to the menu question "Do you wish to alter Pulse Scaling? (Y/N)". The Pulse Scaling screen should be replaced by a "Select Pulse Graphics Resolution" menu.

6) Select the "Low" resolution by entering "1" on the keyboard. The message "**** Graphing Pulse! Please Wait. ****" should replace the Pulse Graphics Resolution menu and should remain on the screen for approximately 4 seconds. The STW is then re-displayed. During this time and for approximately another 4 to 10 seconds, the graphic display calculations are being made. At the end of this period, the reactor display will be erased and the Graphic Pulse display drawn on the high resolution screen.

Notations in this column indicate where changes have been made

7) Verify the pulse plot is what was expected. Verify the alphanumeric data above the plot is the same as what was previously presented for the pulse on the standard resolution screen.

8) Press the "F3" key on the keyboard. The message "Do you wish to graph another Pulse? (Y/N) -->" should replace the STW display.

9) Enter "Y" on the keyboard. Verify other pulses, scalings and resolutions can be properly displayed.

7.5 Exiting the Pulse Graphic Display Mode

1) With a pulse graph on the high resolution display and the STW on the standard screen, press the "F3" key to exit the Pulse Graphic Display mode. The message "Do you wish to graph another Pulse? (Y/N) -->" should replace the STW display.

2) Enter "N" on the keyboard. The message "** Rebuilding Reactor Display ... Please Wait **) should appear on the standard resolution screen. The pulse graph should be erased and the Reactor display redrawn. Upon completion of redrawing the Reactor display, the STW display should be restored to the Standard screen.

8.0 HISTORY LOGGING & PLAYBACK

8.1 History Logging

A History Archive file is automatically produced anytime the reactor is operated. Archiving begins when the Steady-State mode is initiated and continues automatically for 5 minutes following a SCRAM. This procedure describes how to verify the production of a predefined archive file.

1) Re-boot system.

2) Before logging in, remove the history archive file so we can start with a clean slate. To remove the history archive file, select Window 4 by pressing the "Alt-4" keys. This is accomplished by holding the "Alt" key down and then pressing the "4" key on the numeric key pad at the same time. In window 4 enter "RM/MNT/Archive" at the IC-DOS prompt to remove the archive file.

3) Reselect the STW by pressing the "Alt-1" keys.

4) Position all rod drives in the down position.

5) Select and observe the WW and the SCW and clear any warning or SCRAM conditions.

Notations in this column indicate where changes have been made

6) Login and select the Steady-State mode by activating the Reset Key switch. Selecting the Steady-State mode initiates the history archiving process. Record the start of logging time from the Rector display. Observe the archiving process by watching the CSC's hard disk access indicator lite. The lite should flicker once every 10 seconds when the archive file is updated with a new frame.

7) Raise the rods and allow the archiver time to log the new positions.

8) Printout the STW by pressing the "F2" key. Save the printout for comparison during playback.

9) Record data from the Reactor display such as bar graph positons, etc., for comparison during playback.

10) Switch to the WW by pressing the spacebar key and introduce a warning condition such as "Coolant Wtr Inlet Temp". The warning message should appear on both the AW and the WW. Allow the system a short time to archive the warning condition. Note: the system is not only designed to archive periodically as mentioned above but also any time there is a change on the AW, the WW or the SCW. This will be referred to as an Event Log.

11) Remove the warning condition and then acknowledge the warning messages by pressing the Ack button. The warning messages should disappear from both the AW and the WW.

12) Introduce a "Coolant Wtr Pool Temp" warning condition. This should appear in the AW and the WW and also set the reactor display "WTR TEMP" box red.

13) Remove the warning condition and observe the "WTR TEMP" box go black. This will not cause an Event Log since nothing changed in the AW or the WW.

14) Acknowledge the warning condition messages and observe the messages disappear from the AW and the WW. This will cause an Event Log.

15) Select the SCW via the spacebar key.

16) Introduce a SCRAM condition by turning the Reset key switch off and observe the SCRAM message appear in both the AW and the SCW.

17) Drop all the rods and allow or simulate the rod drives to auto wind-down.

18) Introduce a second SCRAM condition by pressing the Manual SCRAM button. Observe the "SCRAM - Manual" message appear on the SCW. Observe that the AW message does not change since its "SCRAM - Key Switch Off" message has not been acknowledged.

Notations in this column indicate where changes have been made

19) Acknowledge the "SCRAM - Key Switch Off" message by pressing the Ack button. The "SCRAM - Key Switch Off" message should disappear from both the AW and the SCW. The "SCRAM - Manual" message, which was queued up, should appear in the AW.

20) Acknowledge the "SCRAM - Manual" message by pressing the Ack button. The "SCRAM - Manual" message should disappear from both the AW and the SCW. All SCRAMs should now be cleared.

21) Select the History Playback menu by pressing the "F4" Function key. Terminate-post SCRAM history logging by selecting item 4 on the menu. REcord the end of history logging time from the Reactor display time. Note: post-SCRAM data logging is automatically terminated 5 minutes following any SCRAM condition and may already have terminated if 5 minutes has elapsed since the first SCRAM condition was initiated.

8.2 History Playback

A History Archive file is automatically produced anytime the reactor is operated. This procedure describes how to verify the playback of the predefined archive file produced by the previous procedure.

1) Before initiating Playback, re-introduce the "Coolant Water Pool Temp" warning condition. Do not acknowledge the warning condition. Note: this condition is not being archived since archiving has been terminated.

2) Select the History Playback menu by pressing the "F4" Function Key and attempt to enter the Playback mode by "Warning; unacknowledged warning message pending" appears below the menu and Playback mode is not initiated. Note: any pending SCRAM or warning messages must be acknowledged before Playback can be initiated.

3) Acknowledge the warning condition by pressing teh Ack button. Do not remove the warning condition. The "WRT TEMP' box on the reactor display should still be red.

4) Select the History Playback menu by pressing the "F4' Function key and enter the Playback mode by selecting item 1 on the menu. Observe that the System mode on the reactor display changes from "REALTIME" to "PLAYBACK-MAN FWD". Observe that the mode changes from SCRAM to STEADY-STATE OPERATE. Verify that the time display changes from realtime to the time when we began History archiving. Observe that the realtime "WTR TEMP" red box and the "Coolant Water Pool Temp" warning conditions have disappeared because we are in playback.

5) Press the "F" key to manually advance to the Next playback frame. Observe the reactor display time increments by 10 seconds.

Notations in this column indicate where changes have been made

6) Continue to manually advance forward through the archive file by pressing the "F" key. Observe the rod drives move up from their bottom positions to the positions we set them during the History logging sequence.

7) Continue forward until the time the STW was printed out occurs. Verify that the STW displays the same information as the printout. Note: the printout time will not exactly coincide with the log interval and some slight deviation of the data may be expected.

8) Compare the Reactor display bar graph positions, etc., with what was recorded earlier and verify that they are the same. Note: some deviation can be expected due to changing date while it was being recorded.

9) Continue forward until the "Coolant Wtr Inlet Temp" warning message appears in the AW and the WW. Note: that this was an event log and did not necessarily occur on the 10 second periodic log interval.

10) Continue forward until the point of acknowledgement occurred in which case both messages disappear.

11) Continue forward until the "Coolant Wtr Pool Temp" warning and the "WTR TEMP" red box appear.

12) Advance until the "WTR TEMP" box goes black.

13) Advance until the "Coolant Wtr Pool Temp" warning messages disappear from the AW and the WW.

14) Switch to the SCW by pressing the spacebar key.

15) Advance forward until the "SCRAM - Key Switch OFF" SCRAM condition is encountered. The SCRAM message should appear in both the AW and the SCW. Observe that the mode changes to "SCRAM".

16) Advance forward until the rods drop and the magnets turn off.

17) Advance until "SCRAM - Manual" also appears on the SCW.

18) Advance until the "SCRAM - Key Switch Off" message was acknowledged in which case the messages disappear from the AW and the SCW. The "SCRAM - Manual" message should now appear in the AW.

19) Advance until the "SCRAM - Manual" message was acknowledged in which case the messages disappear from the AW and the SCW. The AW and the SCW should now be clear.

20) Advance until the end of the archive file is reached. This will be indicated by a "beep" each time the "F" key is pressed.

Notations in this column indicate where changes have been made

21) Select reverse playback by pressing the "R" key. The System mode should change to "PLAYBACK-MAN REV".

22) Advance backwards through the history archive file by pressing the "R" key and verify that everything plays back exactly in reverse to forward above.

23) Advance backwards until the beginning of the history archive file is reached. This will be indicated by a "beep" each time the "R" key is pressed.

24) Select forward playback by pressing the "F" key. The System mode should change to "PLAYBACK-MAN FWD".

25) Advance forward through the archive file displaying A Frame each minute by pressing the Shift/F keys. Observe the greater increment in time covered by each step (5 minutes if no Event Logs were recorded). Note that a number of the recorded events are skipped over and not displayed.

26) Advance forward until the end of the archive file is reached indicated by a "beep" each time the "Shift/F" keys are pressed.

27) Select reverse playback by pressing the "R" key. The System mode should change to "PLAYBACK-MAN REV".

28) Advance backwards through the archive file displaying A Frame/Min. by pressing the Shift/F keys. Observe the greater increment in time covered by each step (5 minutes if no Event Logs were recorded). Note that a number of the recorded events are skipped over and not displayed.

29) Advance backwards until the beginning of the archive file is reached indicted by a "beep' each time the Shift/F keys are pressed.

30) Move to the end of the archive file by pressing the "E" key. Observe that the time changes to the end of the archiving session.

31) Move to the beginning of the archive file by pressing the "B" key. Observe that the time changes to the beginning of the archiving session.

32) Move to the middle of the archive file by pressing the "M" key. Observe that the time changes to approximately the middle of the archiving session.

33) Move to the beginning of the archive file by pressing the "B" key and select the auto playback forward mode by pressing the "A" key. The System mode should display "PLAYBACK-AUTO FWD". Observe that the displays automatically advance at approximately 1 frame each second.

Notations in this column indicate where changes have been made

34) Intermittently press the "F" and "R" keys and verify that auto playback shifts between auto playback forward and auto playback reverse as commanded.

35) Terminate auto playback by pressing the "F" key. Observe the System mode changes to PLAYBACK-MAN FWD

36) Advance to the end of the archive file by pressing the "E" key and then terminate the playback mode by pressing the "F4" key. Observe the System mode changes from "PLAYBACK-MAN FWD/REV" to "REALTIME". Also observe that the realtime "Coolant Water Pool Temp" warnings and the red "WTR TEMP" box are re-displayed since they were left active before playback was initiated.

37) Remove the "Coolant Water Pool Temp" condition and acknowledge the warnings by pressing the Ack button.

8.3 History Backup to Floppy Diskette

History Archive files can be copied from fixed disk to floppy diskettes for permanent storage and subsequent playback. This procedure describes how to verify the floppy diskette backup operation.

1) Select the History Playback menu by pressing the "F4" key and then select item 2, "Backup Archive Data to Floppy Disks". Observe that a History/Pulse Archive select menu appears.

2) Select item 2, "Backup History Archive Data", from the menu. An instructional message to "Insert a formatted diskette in drive A" and to "Strike any key when ready" should appear on the screen.

3) Follow the instructions given above and verify that a message to "Enter a name to identify this diskette, (up to 14 characters) or press return to accept default [Volume - #500018]" is output to the screen.

4) Follow these instructions by pressing the return key. Verify the backup operation in progress by observing the access lites on the fixed disk and the floppy disk drive flicker as data is transferred to the floppy diskette.

5) Follow instructions if more than one backup diskette is required.

6) Upon completion, observe the momentary message "Backup archive has completed" followed by the restoration of the STW to the display.

7) Label and save the backup diskettes for the next procedure.

Notations in this column indicate where changes have been made

8.4 History Restore from Floppy Diskette

History Archive files can be copied from fixed disk to floppy diskettes for permanent storage and subsequen playback. This procedure describes how to verify the restore/playback operation.

1) Before restoring the backed-up history archive file, remove the current history archive file from the hard disk. By invoking playback before and after restoration of the archive file, we can assure ourselves the restoration process actually worked. To remove the history archive file, select Window 4 by pressing the "Alt-4" keys and then enter "RM/USR/GA/DATA/Archive" at the IC-DOS prompt.

2) Reselect the STW by entering "Alt-1". Select the Playback/Archive menu by pressing the "F4" key and select item 1 "Enter History Playback mode". Verify the momentary message "Unable to access History Archive file" appears on the screen followed by restoration of the STW. Note that the mode is still REALTIME and not PLAYBACK.

3) Reselect the Playback/Archive menu by pressing the "F4" key and this time select item 3, "Restore Archive Data from Floppy Disks". Verify that the message "*** WARNING: The old archive file wil be destroyed *** (Do you wish to continue? (Y/N)" appears on the screen.

4) Enter the "N" key in response to the question and observe that the STW is restored to the screen.

5) Again select the Playback/Archive menu and select item 3. This time respond with "yes" by entering the "Y" key. Verify the message "Insert your first archive diskette in drive A: *** Strike any key when ready ***" is output to the screen.

6) Follow the instructions and verify the message "*** Recovering File ... Please Wait ***" is output to the screen and that the hard disk and floppy drive access lites are flickering as the file is being restored.

7) Verify that momentary message "*** Recovery of Archive Data has completed ***" is displayed followed by restoration of the STW.

8) Reselect the Playback/Archive menu and select item 1 "Enter History Playback mode". Verify that the playback mode is actually entered by observing the System mode on the reactor display change from REALTIME to PLAYBACK-MAN FWD.

9) Verify that the history archive file has been restored properly by stepping through the History Playback Procedure described above.

AFRRI "FACILITY INTERLOCK TESTS" CHECKOUT

ATTACHMENT 4

FACILITY INTERLOCK TESTS

A. Move core into position 567.

1. Check that lead shield doors will not close.

B. Move core into position 290 and close lead shield doors half way.

2. Attempt to raise rods and verify loss of air and magnet power.

C. Fully close lead shield doors.

3. check that core can be driven in both directions in region 1.

4. Check that core cannot be driven into region 2.

5. Verify loss of power to ER 1 control panel.

6. Open ER 2, driving all of the way out to ensure that microswitch will stop door.

7. Hold "ER 2 closed" microswitch closed.

D. Open lead shield doors and raise rods. Time delay on (horn sounds in ER 2).

8. Release ER 2 microswitch, testing for scram.

9. Attempt to raise rods.

10. Push in emergency stop button. Hold "ER 2 closed" microswitch closed.

11. Attempt to raise rods.

12. Reset button in ER 2.

13. Reset emergency stop on console.

14. Verify warning horn sounded in both ER 1 and ER 2.

15. Hold "ER 2 closed" microswitch closed.

16. Verify loss of power to ER 1 and ER 2 control panels.

E. Close lead shield doors.

17. Close ER 2.

18. Initiate lead shield door time delay.

ATTACHMENT 2

19. Verify warning horn sounded in ER 2 prior to opening lead shield doors.

F. Open lead shield doors and move core to position 833. Close lead shield doors.

20. Check that the core can be driven in both directions while in region 3.

21. Check that the core cannot be driven into region 2.

22. Verify loss of power to ER 2 control panel.

23. Open ER 1, driving all of the way out to ensure that microswitch will stop door.

24. Hold "ER 1 closed" microswitch closed.

G. Open lead shield doors and raise rods.

25. Release ER 1 microswitch, testing for scram.

26. Attempt to raise rods.

27. Push in emergency stop button. Hold "ER 1 closed" microswitch closed.

28. Attempt to raise rods.

29. Reset button in ER 1.

30. Reset emergency stop on console.

31. Hold "ER 1 closed" microswitch closed.

H. Close lead shield doors.

32. Close ER 1.

33. Initiate lead shield doors time delay.

34. Verify warning horn sounded in ER 1 prior to opening lead shield doors.