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BWR SERVICING AND REFUELING IMPROVEMENT PROGRAM — PHASE I SUMMARY REPORT

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LIST OF ABBREVIATIONS

ASP — Activity Service Plan

BOP — Balance of Plant

BWR — Boiling Water Reactor

CRD — Control Rod Drive

DOE — U.S. Department of Energy

DW — Drywell

ERDA — U.S. Energy Research and Development Administration

GAME — Guide for Activity Monitoring and Evaluation

GE — General Electric Company

ILRT — Integrated Leak Rate Test

ISI — In-Service Inspection

LLRT — Local Leak Rate Test

LPRM — Local Power Range Monitor

MSIV — Main Steam Isolation Valve

MSL — Main Steam Line

MWe — Megawatt Electrical

NSSS — Nuclear Steam Supply System

PASNY — Power Authority of the State of New York

PT — Penetrant Test

RHR — Residual Heat Removal

SLCS — Standby Liquid Control System

SRV — Safety Relief Valve

TIP — Traversing In-Core Probe

TVA — Tennessee Valley Authority

UT — Ultrasonic Testing

VT — Visual Testing

1. PROGRAM DESCRIPTION AND SUMMARY

1.1 PARTICIPANTS

Under the U.S. Department of Energy (formerly U.S. Energy Research and Development Agency) sponsorship, General Electric Co. (GE) undertook a study of boiling water reactor (BWR) refueling outages for the purpose of recommending the development and demonstration of critical path time savings improvements. The Tennessee Valley Authority (TVA) joined the study as a subcontractor, providing monitoring assistance and making the Browns Ferry Site available for improvement demonstrations. Agreement was also reached with Georgia Power Co., Power Authority of the State of New York, and Commonwealth Edison Co. for monitoring and data collection at Hatch 1, FitzPatrick, and Quad Cities 1 nuclear plants, respectively.

1.2 PROGRAM OBJECTIVES

In 1976, as part of the Light Water Reactor Technology Program, the U.S. Department of Energy (DOE), then ERDA, established a refueling outage technology improvement program. The objective was to identify, develop, and demonstrate improved refueling, maintenance, and inspection procedures and equipment. Such improvements would reduce the consumption of oil and gas for the generation of electricity and thus reduce U.S. dependence on foreign energy resources by making better use of existing and future nuclear generation stations.

To carry out this program, DOE elected to assist the nuclear industry through jointly funded programs for the accelerated development and demonstration of improved procedures and new equipment. Table 1-1, Refueling Outage Times BWR Plants During 1977, points out the importance of efforts to reduce refueling outage times. It has been anticipated that an improvement of 3% or more in plant availability is achievable through such a joint DOE-industry effort to reduce refueling outage time.

Table 1-1
REFUELING OUTAGE TIMES BWR PLANTS DURING 1977

Item	Days
Average outage time for all plants	89.4
Longest outage reported	140.0
Shortest outage reported	31.2

The first phase of the program involved the observation of refueling outage activities, analysis of data, preparation of recommendations, editing of photographs, and report preparation. This report, therefore, concludes the first phase of the program.

The second phase of the program covers the actual development, design, procurement, installation, and demonstration of improved equipment as well as the use of improved procedures, scheduling, outage management tools, and equipment and facility modifications not requiring further development.

1.3 PHASE 1 STUDY EFFORT

Phase 1 began with preparation of Activity Service Plans (ASPs) and Guide for Activity Monitoring and Evaluation (GAME) questionnaires in January 1977. These ASPs are contained in Appendix B and consist of descriptions of each activity originally planned to be monitored, as well as estimates of elapsed time, manpower requirements, required tools and spare parts, and man-Rems. During the monitoring at each of the four participating plants actual values were recorded where different from the advanced estimates and this information is also contained in Appendix B. The GAMEs were generic questionnaires to promote creative thinking during monitoring. A significant number of the recommendations contained in this report resulted from use of the GAMEs.

Activity monitoring, data recording, photography, and evaluation were conducted throughout 1977 during refueling outages at Hatch 1, Quad Cities 1, FitzPatrick, and Browns Ferry 1 BWR nuclear plants. The monitoring team consisted of General Electric Co. and TVA delegates. General Electric Co. engineers responsible for specific activities, groups of activities, or components were added to the monitoring team effort at appropriate times during these outages in order to obtain optimum results.

Finally, the data, photographs, and reports were compiled and analyzed by monitoring and design engineers in preparing the recommendations contained in this report. Recommendations have been made in all areas where time savings or man-Rem savings can be realized including: (1) planning for specific activities and the entire outage, (2) manpower applications, (3) scheduling, (4) procedures, (5) training, (6) equipment, (7) shielding, (8) tooling, (9) spare parts, and (10) general housekeeping and cleanliness.

Recommendations included in this report have been categorized as follows:

1. Outage Management and Planning

2. Retrofit Recommendations not requiring Equipment Development

3. Retrofit Recommendations requiring Development (Phase 2 development items)

A critical path analysis was performed to determine the overall outage critical path resulting from the numerous individual activity-related recommendations (Section 7).

A 10-year schedule was prepared for the demonstration plant (Browns Ferry 1) incorporating maintenance cycles for major regulatory guide requirements and balance of plant (BOP) activities.

1.4 SUMMARY AND CONCLUSIONS

The results of the Phase 1 study show that significant improvement in plant availability is attainable. Table 1-2 summarizes the data and results of the critical path analysis provided by this study for the demonstration plant, Browns Ferry 1. The "scheduled" time of 78 days is the refueling outage length as determined by pre-outage planning. The "actual" length of 126 days is the time that was in fact consumed by the outage (Fall 1977 refueling outage). The "typical" refueling outage length of 32 days is the theoretical time that would be required to conduct an outage assuming: (1) no nonrecurring or one-time activities, (2) only one-third of the core is replaced, sipped, and inspected, (3) one-third of the LPRMs are replaced, (4) 10% of the CRDs are replaced, and (5) no unplanned delays. This "typical" outage schedule is used as the basis for the critical path analysis of recommended benefits (see Section 7). The "ideal" refueling outage time of 24 days is derived by applying the benefits of the recommendations contained in this report to the "typical" refueling outage schedule.

Table 1-2
SUMMARY OF CRITICAL PATH ANALYSIS
(days)

	Scheduled	Actual	Typical	Ideal	Additional Expected Annual Savings
Brown's Ferry 1	78	126	32	24	8

This new critical path time represents an expected average annual outage time reduction of 8 days for each plant implementing the recommendations provided by this study. The "typical" and "ideal" nuclear steam supply system (NSSS) refueling outage schedules in this study can be used as a basis for planning future refueling outages, but additions to this schedule will have to be made as a result of periodic and surveillance tests, as well as the required inservice inspections. Although this study was limited to the four specific plants, the findings are applicable to other nuclear plants of similar design and construction.

Four types of savings can result from implementation of these recommendations which are currently applicable to 24 operating BWR units:

1. Savings of an estimated 8 critical path days, resulting in lower replacement power costs. This time savings represents a replacement energy cost savings of about $1.5 million per 1100 MWe unit.

2. An equivalent oil savings. If the replacement power were from an oil-fired unit, the oil savings would be approximately 250,000 barrels.

3. Savings in manpower resulting from approximately 8 less working days during the outage.

4. Significant savings in personnel radiation exposure resulting from fewer people working for shorter times in high radiation fields during an outage.

By 1985 the cumulative annual savings projection is 600 days of refueling outage time and $125 million for an estimated 20 billion barrels of replacement energy fuel oil. These savings are based on an assumed operating capacity of 75,000 MWe supplied by 85 nuclear power plants of GE design.

Recommendations believed to have significant benefits to the industry were evaluated in detail to determine their applicability and the cost benefit for a utility implementing those recommendations. The majority of these recommendations can be implemented immediately by utilities without further technical development. Improvements having significant benefit but requiring further development have been recommended to DOE for prototype demonstration at Browns Ferry 1. These development recommendations are listed in Table 1-3.

Table 1-3
RETROFIT RECOMMENDATIONS REQUIRING DEVELOPMENT WITH EXPECTED SAVINGS AND DELIVERY SCHEDULE

	Benefit Time Saved (hours)	Schedule *	
		Engineering Complete (months)	Delivery (months)
1. Redesign of Reactor Vessel Stud Removal Tools	6	3	9
2. Moisture Separator "T" Wrench Improvements	8	5	12
3. Turbidity Control	72	8	22
4. Reactor Pressure Vessel Stud Cleaning Device	4	2	3
5. Back-fit of BWR-6 CRD Handling Equipment (Figure 5-1)	60	6	12
6. Reactor Pressure Vessel Nut Removal Tooling	16	6	12
7. Service Line Control	4	4	10
8. Rapid Engagement Head Spray Line Connection (Figure 5-2)	12	8	12
9. Back-Fit BWR-6 Refueling Platform	40	8	17
10. Reactor Pressure Vessel Head Tensioning/ Detensioning Improvements	40	8	20
11. Loose Parts Prevention Program	48	8	14
12. Develop Minimum Pass Tensioning/Detensioning Sequence	15	12	12
13. Reactor Pressure Vessel Stud Thread Lubricant Application	2.5	8	14
14. Loose Parts Retrieval Program	45	10	15
15. Reactor Cavity Elevator (Figure 5-4)	15	10	16
16. Communications	24	18	28
17. Decontamination Equipment (Figure 5-5)	8	8	10
18. Multiple LPRM Handling Strongback (Figure 5-6)	7	3	8
19. Reactor Pressure Vessel Recirculation Outlet Nozzle Debris Screens (Figure 5-7)	4	2	6
20. Reactor Pressure Vessel Recirculation Outlet Nozzle Plugs (Figure 5-8)	4	2	6
21. Main Steam Line Plug Holder	4	8	20
22. Optical Positioning of Refueling Platform Grapple	24	10	18
23. Improve Rotating Platform Drives	1	4	7

* After Receipt of Order

In conclusion, the improvements recommended in this study are applicable to BWR nuclear plants currently in operation as well as those in the design and construction phases. The recommendations and outage information contained in this report can be used as a basis to plan and conduct the first outages of new plants and to improve the planning and facilities of currently operating plants. Many of the recommendations can readily be incorporated in plants currently in the design and construction phases as well as in the design of future plants. Many of these recommended improvements can be implemented immediately by utilities without further technical development. Planning for Phase 2, recommendations requiring development, is underway.

2. DESCRIPTION OF MONITORED ACTIVITIES

Table 2-1 describes each refueling outage activity monitored. All activities that are considered critical path and numerous additional activities are included. Activities 1 through 50 are critical path activities listed in approximate chronological order. The remaining activities, 51 through 65, are not normally critical path activities. These latter activities are essentially independent and their listing is not intended to imply sequence. Appendix A is a photographic display of the refueling activities monitored during Phase 1 and is used to illustrate the activity descriptions.* Appendix A also contains general area and balance-of-plant (BOP) activity photographs. The chronology of Appendix A is not intended to coincide with the tabular listing in this section.

Monitoring was also conducted to a limited extent in the BOP areas of the turbine and reactor buildings. This effort began late in Phase 1 and was authorized by a supplemental contract agreement between the General Electric Co. and the U.S. Department of Energy, effective February 1, 1978. Time was not available, however, to perform the advanced planning for this BOP effort to the extent that had been done for the original scope (NSSS) activities. This section and Appendix B describe the NSSS but not the BOP activities. Recommendations for the BOP activities are contained in Section 3.

* Photographs were taken at Hatch 1, Quad Cities 1, FitzPatrick and Browns Ferry 1.

Table 2-1
DESCRIPTION OF MONITORED ACTIVITIES

Activity No.	Activity Title	Description	Activity Times Min (hrs)	Max	Avg	Appendix A Photo No.
1	Remove Reactor Well Shield Blocks	Inspect and assemble rigging, rig to lift, and store blocks	3	3	3	30,31,32
2	Remove Equipment Pool Shield Blocks	Rig, remove, and store four blocks.	1.5	6	3	33,34,77
3	Remove Fuel Pool Shield Blocks	Rig, lift, and store blocks.	1	2	1.5	
4	Unbolt Drywell Head	Unbolt drywell head and store bolts.	3	6	4.5	35,36,37,38, 39,40
5	Rig and Lift Drywell Head	Lay cribbing; inspect and adjust strongback; rig, lift, and store drywell head.	0.5	4	2.5	43,44,45,46
6	Remove Head Spray and Vent Line Piping	Remove piping insulation, head piping; unbolt five flanges; install blind flanges; remove pipe restraints; rig, lift, and store head spray line.	4	18	9	48,49
7	Remove Head Insulation	Unbolt (if applicable), uncouple thermocouples, disconnect vent ducting, lift and store package, reconnect thermocouples.	1	5	3	47,50,51,52
8	Install Spider or Stud Tensioner	Rig, lift, and position in place.	0.5	2	1	57,58,59,60
9	Detension Studs	Sequentially detension studs by pressure sequence.	0.11/ Stud	0.48/ Stud	0.23/ Stud	61,63
10	Remove Stud Tensioners	Rig, lift and store carousel.	0.25	2	0.38	58,62
11	Remove and Lift Nuts and Washers, and Install Stud Protectors	Lower nut rack, remove nuts and washers, install thread protectors, lift and store nuts and washers.	0.03/ Stud	0.08/ Stud	0.06/ Stud	63,64
12	Vacuum Ventilate Reactor Pressure Vessel Head	Ventilate Reactor Pressure Vessel Head	3.5	6	5	54,55,56
13	Close and Seal Drywell Manways	Clean sealing surface, install O-rings, bolt down latch covers.	1	2	1	

Table 2-1
DESCRIPTION OF MONITORED ACTIVITIES (Continued)

Activity No.	Activity Title	Description	Activity Times Min	Max	Avg	Appendix A Photo No.
			(hrs)			
14	Transfer RPV Head to Laydown Area	Attach and adjust strongback; rig, lift, and store head; and install flange protector.	2	15	7	65,66,67
15	Remove Steam Dryer	Adjust and attach strongback, lift and store in equipment pool.	1	3	2	78,79,80,81
16	Remove Transfer Slot Studs	Rig and lower stud racks, install stud removal tool, remove studs, store studs in racks, remove and store racks.	0.5	30	9	71,72
17	Install Main Steam Plugs and Drain Steam Lines	Install main steam plugs and drain steam lines.	1.5	5	3	93,94
18	Install Cattle Chute	Rig, lift, install cattle chute.	0.5	1.5	1	101,102,103, 104
19	Unlatch Moisture Separator	Unlatch moisture separator holddown bolts, adjust strongback turn-buckles, attach strongback to separator. Verify latching.	3	8	6	
20	Flood Cavity and Transfer Separator Underwater	Flood reactor cavity, lift and store separator in equipment pool.	2	17	10	82,83,84,85, 86,87,88
21	Cleanup Water	Purify water at maximum rate.	8	72	30	105
22	Unload Fuel	Transfer fuel bundles to fuel pool, install blade guides and dunking chambers.	0.2/ Bu.	0.67/ Bu.	0.34/ Bu.	106 to 117
23	Fuel Sipping	Transfer fuel to sipping cans, sip fuel, return fuel to storage racks and analyze samples.	1.3/ Can	1.7/ Can	1.5/ Can	
24	Install Equipment Pool Shield Blocks	Rig and install equipment pool shield plugs.	3	5	4	89,90,91,92
25	Install Fuel Pool Shield Blocks	Rig, lift and set the fuel pool shield blocks.	1	1	1	
26	Drain and Decontaminate Reactor Well	Drain and decontaminate reactor well.	24	67	51	97,98,99,100

Table 2-1
DESCRIPTION OF MONITORED ACTIVITIES (Continued)

Activity No.	Activity Title	Description	Activity Times Min (hrs)	Max	Avg	Appendix A Photo No.
27	Install Service Platform	Assemble and install track; rig, install and operationally check service platform.	0.5	0.75	0.6	136,137,138
28	RPV ISI (Underwater)	Visually inspect jet pumps, core spray system, cladding patches, and LPRM's (if required) for cracks, cracked welds, indication of movement, etc.	8	56	19	
29	Jet Pump Plug Removal	This task was performed from the refueling bridge. Removal of jet pump plugs (one loop).	2.5	13	8	
30	Remove Service Platform	Rig to lift and store service platform.	0.5	1	0.75	
31	Remove and Replace LPRM's	Remove LPRM, bend and store in fuel pool, attach to strongback and position replacement LPRM in reactor well, transfer weight of LPRM to instrument handling tool, place LPRM in proper position and verify latching with TV camera.	1hr/ Unit	2hr/ Unit	1.5hr/ Unit	146,148,165, 166,167,168
32	Reload Core	Install fuel bundles, remove blade guides and dunking chambers.	0.16 hr/ Bu.	0.5 hr/ Bu.	0.3 hr/ Bu.	177,178
33	Verify Core Loading	Inspect and record fuel location (using TV camera), and verify bundle seating by traversing grapple just above bales.	5	19	13.5	179
34	Functional/Friction Test CRD System	Cycle and vent hydraulic control system, perform stroke timing and differential pressure measurement friction testing for all CRD's.	21	68	43	180,181
35	Transfer Dry and Install Moisture Separator	Install rigging, lift and install separator, remove strongback.	2.5	14.5	8	
36	Remove Main Steam Line Plugs	Attach strongback, deflate, and remove steam line plug.	1	7	2.5	

Table 2-1
DESCRIPTION OF MONITORED ACTIVITIES (Continued)

Activity No.	Activity Title	Description	Activity Times (hrs) Min	Max	Avg	Appendix A Photo No.
37	Torque Moisture Separator	Latch moisture separator holddown bolts.	1	13	5.5	
38	Install Steam Dryer	Attach strongback; rig, lift, and position in reactor vessel.	1	2	1.5	
39	Install Transfer Slot Studs	Rig and lift stud storage racks into reactor well, install studs, install remaining protectors.	2	3	2.5	74,75,76
40	Remove Flange Protectors, Clean Flange	Remove flange protectors and clean vessel flange.	0.5	2	1	
41	Install Reactor Pressure Vessel Head	Rig strongback to RPV head, clean flange, install O-rings.	3	14	7.3	
42	Remove Stud Protectors and Install Nuts and Washers	Lower nuts and washers into reactor well, remove stud protectors, clean and lubricate studs, install washers, and install nuts.	5	24	13	
43	Tension Reactor Pressure Vessel Studs.	Measure unloaded studs; tension studs; make final measurements, calculations, and adjustments.	27	40	32	
44	Install Reactor Pressure Vessel Thermocouples and Insulation	Install thermocouples, install insulation package, connect thermocouples.	1.5	8	4	
45	Install Head Vent and Spray Piping	Rig, lift, and position head spray line; remove blind flanges; connect and bolt five flanges; install pipe restraints and insulation.	13.5	24	16.5	
46	Perform Reactor Pressure	Pressurize vessel, inspect for leaks.	4.5	72	36	
47	Open Drywell Vents	Open drywell vents.	0.5	0.5	0.5	
48	Install Drywell Head	Clean flanges, install O-rings, rig and install drywell head.	2	6	4.5	
49	Bolt and Leak-Rate Test Drywell Head	Torque drywell head bolts, leak-check.	6	14	10	
50	Install Reactor Well Shield Blocks	Rig, lift, and install two layers of reactor well shield blocks.	4	10	7	

Table 2-1
DESCRIPTION OF MONITORED ACTIVITIES (Continued)

Activity No.	Activity Title	Description	Activity Times Min (hrs)	Activity Times Max (hrs)	Activity Times Avg (hrs)	Appendix A Photo No.
51	Channel Inspection	Visual inspection of wear marks for comparison against a calibrated standard.	6.5	24	15	
52	Drywell Entry	De-inert drywell, cool down, take radiation surveys, make oxygen analysis. Inspect for leaks.	0	24	10	
53	Torus Inspection	Inspect visible piping supports, ring girder, catwalk, penetrations (both internal and external), and paint.	60	336	200	229,230,231
54	Containment Valve Testing	Leak rate and functional test per technical specifications.	2 hr/ Val.	2 hr/ Val.	2 hr/ Val.	242
55	MSIV Leak Rate Test	Make test connections and perform rate test.	8	40	20	
56	MSIV Repair	Disassemble, lap valve seat and pilot seat, machine poppet seat, reassemble, repair operators as required.	36 hr/ Val.	96 hr/ Val.	70 hr/ Val.	185 to 199
57	Inservice Inspection	Remove insulation, build scaffolding, clean required areas, calibrate equipment, UT inspect, clean up areas inspected, replace insulation, remove scaffolding.	120	450	285	226,227
58	Testing and Replacement of O-Rings on Personnel Air Lock	Replace O-rings, secure inner door, test air lock, test interlock system.	8	12	10	
59	CRD Removal and Replacement	Remove and transfer to rebuild area, move from rebuild area, and replace.	2 hr/ Dr.	6 hr/ Dr.	4 hr/ Dr.	149 to 157
60	Recirculation Pump Motor Testing	Perform electrical tests and mechanical run-out checks.	2	2	2	241
61	Drywell Exit Inspection and Resilient Seal Testing	Test resilient seals, repair as required, visually inspect drywell for operational readiness.	20	26	23	

Table 2-1
DESCRIPTION OF MONITORED ACTIVITIES (Continued)

Activity No.	Activity Title	Description	Activity Times (hrs) Min	Max	Avg	Appendix A Photo No.
62	Inspect and Service Drywell Cooling Units	Perform general inspection (both with units operating and while shut down), perform electrical test, repair as necessary.	1 hr/ Unit	4 hr/ Unit	3 hr/ Unit	
63	Safety Relief Valve Air Supply Testing and Servicing	Test operation of each instrument air supply, check valve and accumulator, replace or repair as necessary.	4	8	6	200 to 213
64	Inspect and Repair Snubbers	Visually inspect all snubbers, remove and test 10 snubbers, rebuild and retest as necessary.	30	70	50	214 to 225
65	Traversing In-Core Probe Servicing	Overhaul indexer, drive, service and/or replace tubing.	40	8	36	172,173,174

3. OUTAGE MANAGEMENT AND PLANNING

This section contains recommendations that could be implemented near term at any BWR plant. These recommendations involve management, planning, maintenance and operating procedures, techniques, tooling, organizing, spare parts, etc., but not equipment modifications, additions, or development. Estimated savings in critical path time and man-Rem are itemized in Table 7-1 of Section 7.

3.1 MAINTENANCE PROCEDURES

Maintenance procedures should be updated prior to each refueling outage. The following problem areas were noted:

1. Equipment modifications are not always reflected in the procedures, and time is wasted reading outdated procedures.

2. Tools and spare parts are not identified in the procedures. Time is lost identifying and locating proper tools and spare parts.

3. Manpower requirements are not identified. Time is wasted getting the proper crafts on the job.

4. Elapsed time estimates are not identified. Time is lost between jobs because completions were not accurately anticipated and preparations for the next activities were not completed.

3.2 WATER CLARITY

1. Improved operating procedures for flushing systems, flooding the cavity, and using alternate systems would result in better water clarity.

2. Optimized scheduling of strainer and filter/demineralizer servicing would increase cleanup capacity and efficiency.

3. Precoating the reactor water cleanup system demineralizer with Ecodex (or equivalent) in lieu of Powdex, 2 days prior to reactor shutdown and when necessary during the refueling outage would improve water clarity.

3.3 UNBOLTING DRYWELL HEAD

The use of four air wrenches instead of two would reduce the time required to unbolt the drywell head. It may be necessary to increase the supply air capacity if the number of air wrenches are increased.

3.4 REMOVAL OF RPV HEAD INSULATION

Insulated gloves should be used by personnel removing the RPV head insulation. Time was lost trying to handle hot insulation with rubber gloves. In addition, damage to the insulation resulted when the hot insulation was dropped.

3.5 RPV HEAD STUD TENSIONER

1. A spare stud tensioner would save critical path time in the event of stud tensioner failure.

2. The preventive maintenance concept of overhauling two stud tensioners after each refueling outage would increase their reliability and reduce repair time during critical path time.

3.6 TRANSFER SLOT RPV HEAD STUDS

It is recommended that the transfer slot studs be removed prior to RPV head removal. This would eliminate the possibility of dropping foreign objects into the RPV during stud removal.

3.7 COOLDOWN OF DRYWELL

It is recommended that additional drywell coolers be put in operation 8 hours before reactor shutdown. This will facilitate early drywell entry and allow drywell head and insulation removal to be accomplished under more tolerable conditions. Crews may not have to be rotated, due to heat exhaustion, as frequently.

3.8 REFUELING BRIDGE

Breakdowns during refueling have resulted in many hours of lost time. A reliability program for the refueling bridge should be developed at each plant. This program should include either seminars or training sessions, or both, for bridge operators and maintenance personnel. In addition, a detailed preventive maintenance program should be enacted. Incorporating changes which improve the operation of the refueling bridge and maintaining an adequate supply of spare parts will reduce the downtime of the bridge.

3.9 VERIFICATION OF CORE LOADING

It is recommended that at least one spare television camera of each type needed be available for activities on the critical path. Time lost while awaiting camera repairs at some sites was significant.

3.10 STEAM LINE PLUG INSTALLATION AND REMOVAL

Many plants utilize the overhead auxiliary crane for removing and replacing the steam line plugs. This crane does not have the sensitive control needed. It is recommended that a chain fall be used in conjunction with the auxiliary hoist. The use of a chain fall will give the sensitive "feel" required. In addition, close voice communications will be more effective than hand signals for sensitive control.

3.11 RPV HEAD NUT INSTALLATION AND REMOVAL

The use of four air impact wrenches instead of two would speed up this operation considerably. If the air compressor capacity is not sufficient, increasing its capacity should be considered.

3.12 CONTROL ROD DRIVE REBUILDING

1. An inventory of spare rebuilt control rod drives (CRD) would reduce activity duration and man-Rem exposure for CRD removal, rebuilding, and replacement. Approximately 10% or the number usually repaired is recommended for spare inventory.

2. Spare collets that have been dye penetrant checked should be available for any CRDs that must be rebuilt during the outage. This will reduce rebuilding time and man-Rem exposure.

3. The following available new tools would aid personnel in rebuilding CRDs more efficiently and also reduce radiation exposure:

   a. Filter Removal Tool. This tool is used to remove the outer filter. Foreign material which becomes lodged between the mating surfaces of the filter and the CRD guide cap makes removal of the filter can difficult. This tool provides an effective means of removing the filter. It also eliminates direct contact with the filter, which can be highly contaminated.
   b. T-Handle Assembly. This tool is used to remove the guide cap plugs.
   c. Control Rod Drive Jacking Tool and Block. The jacking tool and block are used to push on the index tube once the stud and inner filter have been removed. The tool is designed to provide sufficient mechanical advantage to dislodge the stationary piston from the CRD cylinder bore.
   d. Shoe. The nylon shoe is used to protect both the index tube and the CRD cylinder bore when the index is being removed.
   e. Collet Assembly Insertion Tool. This tool is used when collet piston rings are replaced to correct failures identified during the CRD leak test. It facilitates the insertion of the collet assembly with the tube in place. It is used in conjunction with the collet ring compression tool currently in use.

3.13 CRD RETRACTION FIXTURE

During removal of a CRD from its housing in the reactor vessel, if the CRD inadvertently recouples to the control rod, the CRD index tube will extend as the CRD is lowered. In such an event, this fixture will permit hydraulic retraction of the index tube as the CRD is reinserted into the housing. Using this method, the control rod remains backseated as the CRD is reinserted. This fixture is similar to the standard leak test fixture and can also be used for leak testing. To facilitate its use below vessel, threaded holes, instead of retaining nuts, are used to secure the fixture to the drive, and the water port is provided at right angles.

3.14 LOCAL POWER RANGE MONITOR (LPRM)

It is recommended that an inspection be done to verify the latching of all LPRMs after all LPRMs have been replaced.

The instrument handling tool, used to replace LPRMs, has operated sluggishly when excessive amounts of water have been present in the air lines. This sluggish operation of the instrument handling tool has resulted in difficulty in latching LPRMs. Thus, to prevent sluggish operation of the instrument handling tool it is recommended that the operating air be free of water. This will require continuous draining of the air lines at plants with a high humidity.

In addition, LPRM replacement can be done more efficiently if those LPRMs which are difficult to latch with the instrument handling tool are left unlatched, and later latched manually. The manual latching should be performed during the latch inspection. The manual latching of LPRMs has been performed using the manual latching tool that is now available.

3.15 DROPPED ARTICLES IN THE REACTOR PRESSURE VESSEL

Almost every outage is delayed by articles inadvertently dropped into the reactor pressure vessel. Several suggestions to minimize this are:

1. **Pre-Shutdown**
   a. Caution all workers and supervisors about the consequences of dropped articles. It is suggested that this be in conjunction with the Radiation Protection indoctrination classes.
   b. Clean the refueling floor, particularly the area around the cavity.
   c. Carefully inspect all tools for loose parts or breaks.
   d. Any tools with removable segments should have the removable segments lock-wired, tied, or taped to the main body. If this is not feasible, minimize or, if possible, avoid using the tool.
   e. Inspect the service platform, refueling bridge, and crane for loose items.
   f. Post warning signs.

2. **Shutdown**
   a. Place a solid guardsheet around the cavity. Attach the guardsheet to the railing and run flush to the floor.
   b. To the greatest extent practical, secure all tools with lanyards either to the operator or a solid restraint. On small tools it may be more practical to attach a float to the tool.
   c. Establish a tool exclusion area around the reactor pressure vessel.
      (1) All tools brought into this area should be approved for use within the reactor vessel.

(2) All tools must be logged into the area and logged out when no longer required. Emphasize the importance of removing all tools from the work areas as soon as possible.

d. Supervisors should check work areas on a routine basis. A clean work area and a place for each item is a key to minimizing tool droppage.

e. Personnel entering the tool exclusion area should be required to empty all pockets. This means establishing a safe area for storing personal valuables.

f. Radiation protection personnel controlling entry to the containment should make a final personnel check for loose articles.

g. When wearing glasses, headbands should be required.

h. Provide baskets or boxes to hold tools and items which cannot be tied to stationary restraints. The boxes should be securely fastened to prevent them from being knocked into the vessel.

3. **Other**

a. Consider covering the bottom of the service platform.

b. Color tools and other articles to make them bright and easily visible. In the event they are dropped into the vessel, it makes retrieval easier.

3.16 FUEL LOADING (DUNKING) CHAMBER HOSE ROUTING

To reduce interference and delays during fuel movement caused by the dunking chamber hose, a hook could be utilized to move the dunking chamber hose away from the path of fuel movement. One end of the hook could be attached to the hose, the hose is then pulled out of the way and the other end of the hook is attached to one of the feedwater sparger headers.

3.17 TOOL AND LOOSE PARTS CONTAINERS

Considerable time and effort can be saved by providing containers for tools and loose parts. Areas such as the catwalk inside the torus and catwalks at different levels in the drywell seem to always have tools and loose parts scattered around. Containment of these parts and tools would prevent chasing for dropped items at the lower levels and would reduce the possibility of personnel injury.

3.18 PLANNING AND SCHEDULING OF CONTAINMENT VALVE REPAIR

Containment valve leak rate testing should be completed as soon as possible in the refueling outage. As soon as it is known which valve will need repair, a schedule should be prepared for repair and retest of these valves. Consideration should be given to line isolation, line draining, valve tag out, tools, and spare parts. Also, parallel or interfering operations, testing, or other maintenance activities should be factored into the schedule.

3.19 DOCUMENTATION AND FOLLOWUP ON IMPROVEMENT SUGGESTIONS

During an outage, suggestions are made by the craft and supervisory personnel concerning tool adaptions, fixtures, etc., that would facilitate specific activities. Since there usually is insufficient time, material, or manpower right then to develop these innovations, the majority of the ideas are forgotten. A system for collecting, evaluating, and following up on such ideas should be employed.

3.20 GENERAL AREA CLEANING AND HOUSEKEEPING

One important consideration during an outage is general area cleaning and housekeeping. Indirect results can be significant in the areas of tool control, spare parts control, personnel injury, equipment damage, efficient work performance, and personnel attitude toward the work.

3.21 SAFETY RELIEF VALVE FLANGE BOLTING

Several safety relief valves are usually removed and replaced each refueling outage. The accessibility to these valves is very limited. Using a torque wrench with a 4-foot handle for reassembly in these areas of limited access is cumbersome and time consuming. An electric or pneumatic torque wrench could be used to reduce assembly time and man-Rem exposure.

3.22 BALANCE OF PLANT (BOP) ACTIVITIES

Monitoring of the BOP areas was conducted to a limited extent and it was determined that these activities are planned and executed largely in a parallel, independent manner. This work was not noted to be the critical path during any of the monitored refueling outages. Use of additional manpower and additional work shifts could shorten these activities' durations, if necessary.

4. RETROFIT RECOMMENDATIONS NOT REQUIRING EQUIPMENT DEVELOPMENT

Estimated savings in critical path time and man-Rem are itemized in Table 7-1 of Section 7.

4.1 MAIN STEAM ISOLATION VALVE LEAK TESTING MANIFOLD

Permanent leak test piping for both the inboard and outboard main steam isolation valves (MSIVs) should be provided by installing a tee connection at each valve drain line. All test lines from these tees should be piped to an area outside the primary containment and into a manifold. (Double isolation valves would be required in each line.) With this system leak testing could be performed in lower radiation areas and from one location.

4.2 RUBBER-SEATED VALVES

The sealing surfaces on the torus vacuum breaker valves are made of a rubber material that tends to gum up and cause leakage after some period. This is probably due to environmental conditions in this area. A more heat-resistant material might be used.

4.3 CRD SERVICING PLATFORM

Some of the CRD servicing platforms were manufactured with only a narrow platform grating along each side of the center slot. This limits the work area and also leaves an open area that might be considered unsafe. By extending the grating over the entire radius with the exception of the center slot, personnel would have more room to work, less rotation of the platform would be required, and the work could be completed more efficiently.

4.4 MAIN STEAM SAFETY RELIEF VALVE TRANSFER

Several safety relief valves usually require removal for testing during each refueling outage. Some plants have jib booms over each valve area for removing the valves from the main steam headers. However, the transfer from the main steam header area to the lower level is difficult. It would be beneficial to have a monorail for transporting and lowering the valves to the lower level.

4.5 CONTROL ROD BLADE GUIDES

The fuel bundle spring clips occasionally catch the blade guide crossbars when the fuel bundles are being lowered into position. This causes the spring clip bolt to become bent. It is recommended that a bevel be applied to the top of the control rod blade guide crossbars.

4.6 HEAD SPRAY PIPING

Critical path time has been lost during the installation of the head spray piping due to difficulty in aligning and installing the Flexitallic gasket in position on the flange. The flange makeup is tongue and groove and it would be much better if the groove flange were on the RPV head rather than on the piping portion. Also, installation of an additional guide pin at another position to maintain correct orientation would be helpful during flange fitup. A wrench that could be used from the reactor cavity during flange assembly and disassembly should be developed. Currently, a workman must enter the drywell to keep the bolts from turning.

4.7 REFUELING PLATFORM

1. To eliminate the refueling bridge twisting on the tracks, it is recommended that end track guide roller assemblies be installed at all four positions of the refueling bridge.

2. Moisture in the supply air causes malfunction of the air valves. The installation of moisture separators with automatic blowdown valves would help to eliminate this problem.

Critical path time has been lost due to failure of the power cables. It is recommended that all power cables be positioned with a minimum of a 12-inch radius. This will help prevent internal shorts in the power cables.

4.8 CRD REMOVAL AND REPLACEMENT

Utilization of the CRD housing flange attachment in use at Browns Ferry 1 (see Figure 4-1) would save time during the control rod drive removal and replacement. This attachment is placed over the CRD flange, three latches drop into place and support the flange. Mating bolts and nuts in a tight place while wearing Anti-C clothing is eliminated.

4.9 MSIV TEST FIXTURES

1. The test fixture developed at Browns Ferry to test the pilot valve seat prior to reassembly of the MSIV saves time by eliminating unnecessary assembly and disassembly of the MSIV (Figure 4-2).

2. Also at Browns Ferry, a test plug (Figure 4-3) is used to seal the inboard MSIV to obtain accurate test results on the outboard MSIV. This permits independent work on the inboard MSIV internals.

4.10 FUNCTIONAL FRICTION TEST — CRD SYSTEM

Improved communication would result from the installation of a sound-powered telephone system between the control rod drive hydraulic unit area and the control room. The use of radio communications (walkie-talkies) interferes with the operation of the oscilloscope and the public address telephone system experiences frequent interruptions.

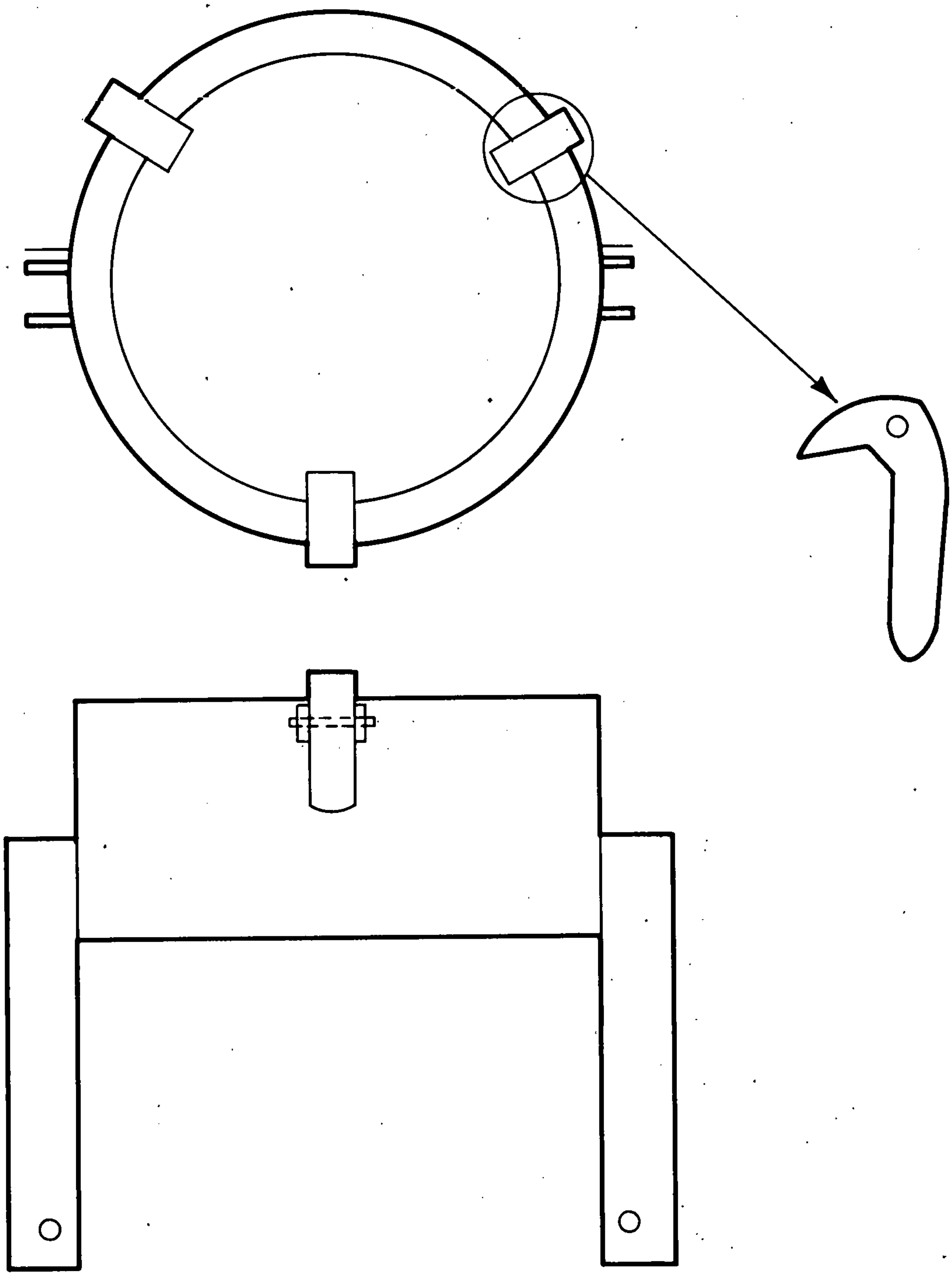


Figure 4-1. CRD Housing Flange Attachment at Browns Ferry 1

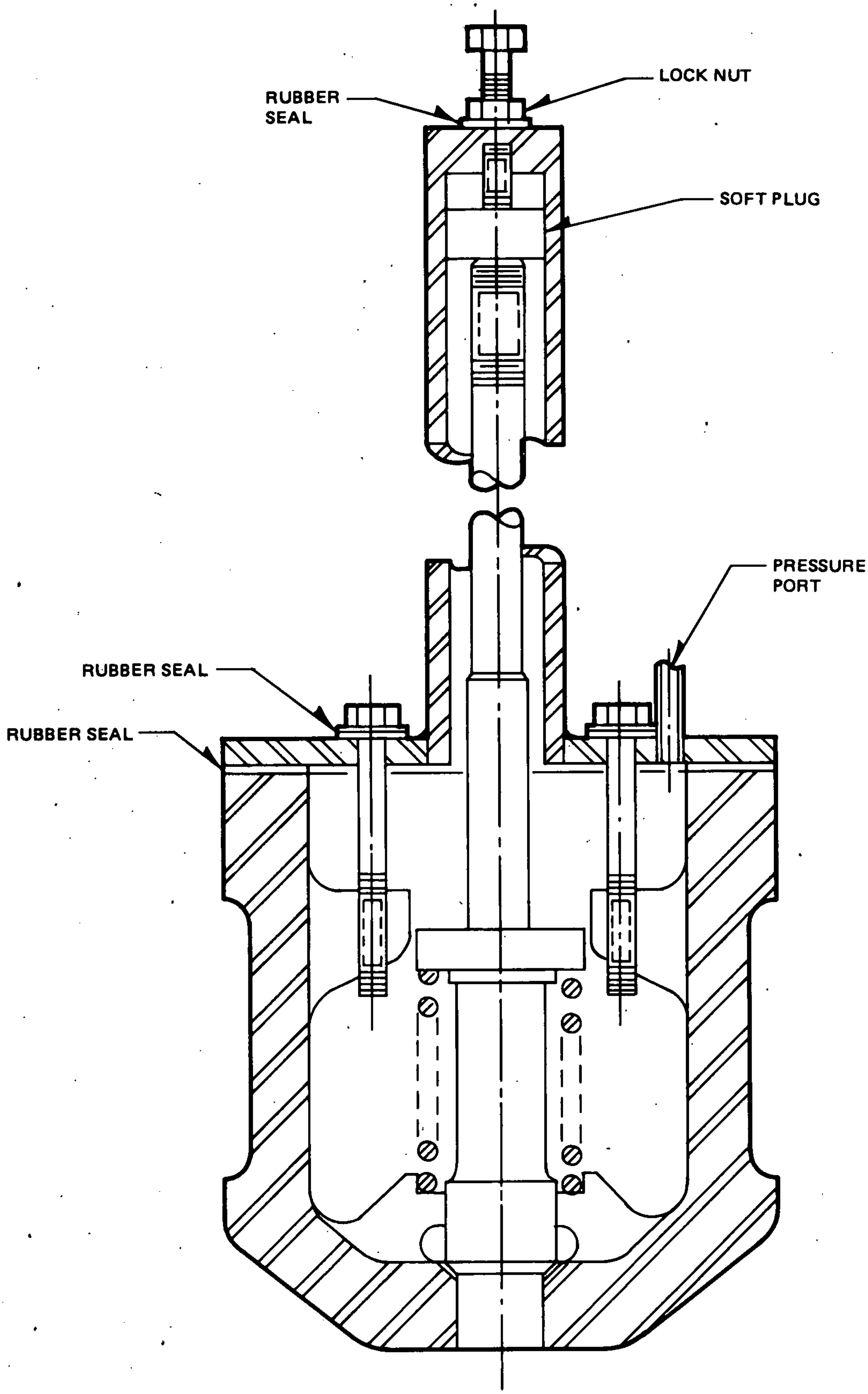


Figure 4-2. MSIV Pilot Test Fixture

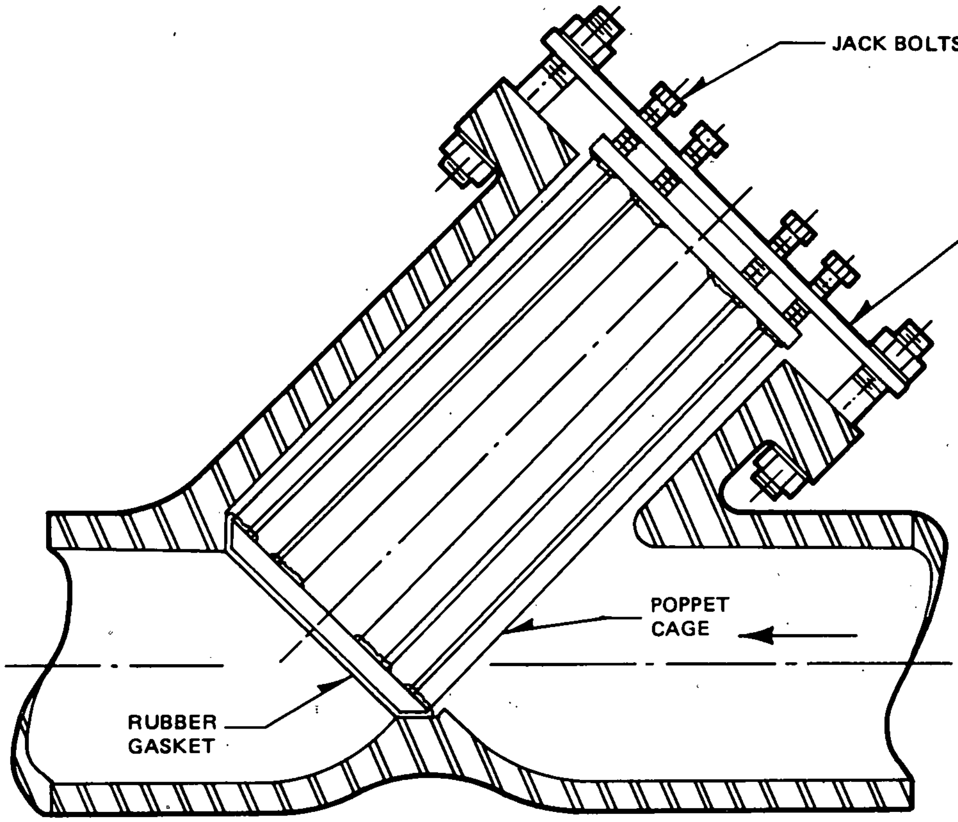


Figure 4-3. Inboard Valve (MSIV) Test Plug

4.11 MOISTURE SEPARATOR REMOVAL AND INSTALLATION

Time was lost trying to verify the latching and unlatching of the moisture separator strongback. It is difficult to see the position of the plunger relative to the hydraulic cylinder. Verification could be improved by attaching a tab to the plunger that would extend alongside parallel to the hydraulic cylinder. Then the tab, which is attached to the plunger, could be painted with contrasting color rings. In this way, any mismatch could be easily seen through the water and latching easily verified.

4.12 CONTROL ROD DRIVE REMOVAL AND REPLACEMENT

1. CRD transfer tunnel lighting. Poor lighting in the tunnel has contributed to delays in moving the CRDs out of and into the drywell. A special purpose permanent (or portable) lighting system should be installed.

2. CRD Hoist Electrical Power Cables. These cables have caught on the CRD platform and have been pulled loose resulting in significant activity delays. These cables should be rerouted so that they come up from under the hoist and cannot hang up on the CRD platform.

3. CRD Hoist Cable Breakage. A heavy overload spring attached at the CRD flange and supporting the hoist cable at this high point would absorb the overloads frequently induced by CRD misalignment or bottoming during installation. The spring arrangement must be stiff enough to permit normal loading with minimum deflection and still compress (extend) adequately during overload to prevent cable breakage.

4.13 REFUELING PLATFORM — FUEL GRAPPLE

It is recommended that electromagnetic-type proximity switches supplement or replace the electromechanical switches. The electromechanical switches are prone to failure of the mechanical parts.

5. RECOMMENDATIONS REQUIRING DEVELOPMENT

This section contains recommendations that require the development of new or modified equipment, procedures, and methods, which can be retrofit to existing BWR plants. Estimated time savings for each recommendation are included. Table 7-1 in Section 7 itemizes time savings and man-Rem savings estimates.

5.1 REDESIGN OF REACTOR VESSEL STUD REMOVAL TOOLS

Reduce stud removal and installation time by redesign of tooling. The new tool will consist of airpower or electric motor drive. The tool will balance to support the stud weight and develop adequate torque to break loose and unthread the studs. It will be designed to remove the studs with the reactor head either in place or removed. (6 hours)

5.2 MOISTURE SEPARATOR T-WRENCH IMPROVEMENTS

During removal and replacement of the moisture separator, the shroud head bolt keepers frequently stick. During removal the keepers are difficult to depress as required to permit head bolt loosening. During replacement, the keepers stick in the depressed, disengaged position and do not spring return to the locked position when the T-wrench is removed. It is therefore recommended that the moisture separator T-wrench be redesigned or modified to permit easier disengaging for removal and alignment and engaging for replacement. ((8 hours)

5.3 TURBIDITY CONTROL

The objective is to eliminate outage delays caused by poor water clarity (turbidity). This recommendation is for developing an optimized, supplemental, cleanup, and holding system to establish and maintain the required water clarity. (72 hours)

5.4 REACTOR PRESSURE VESSEL STUD CLEANING DEVICE

Develop a stud cleaning device which will be an insert installed in the nut removal tool. The tool will require an integral debris collector. (4 hours)

5.5 BACK-FIT OF BWR-6 CRD HANDLING EQUIPMENT (Figure 5-1)

The objective is to significantly improve equipment control, efficiency, and speed, as well as reduce man-Rem exposure when performing CRD maintenance. Necessary design modifications to provide the improved CRD handling equipment now being used for BWR-6 plants would be included. (60 hours)

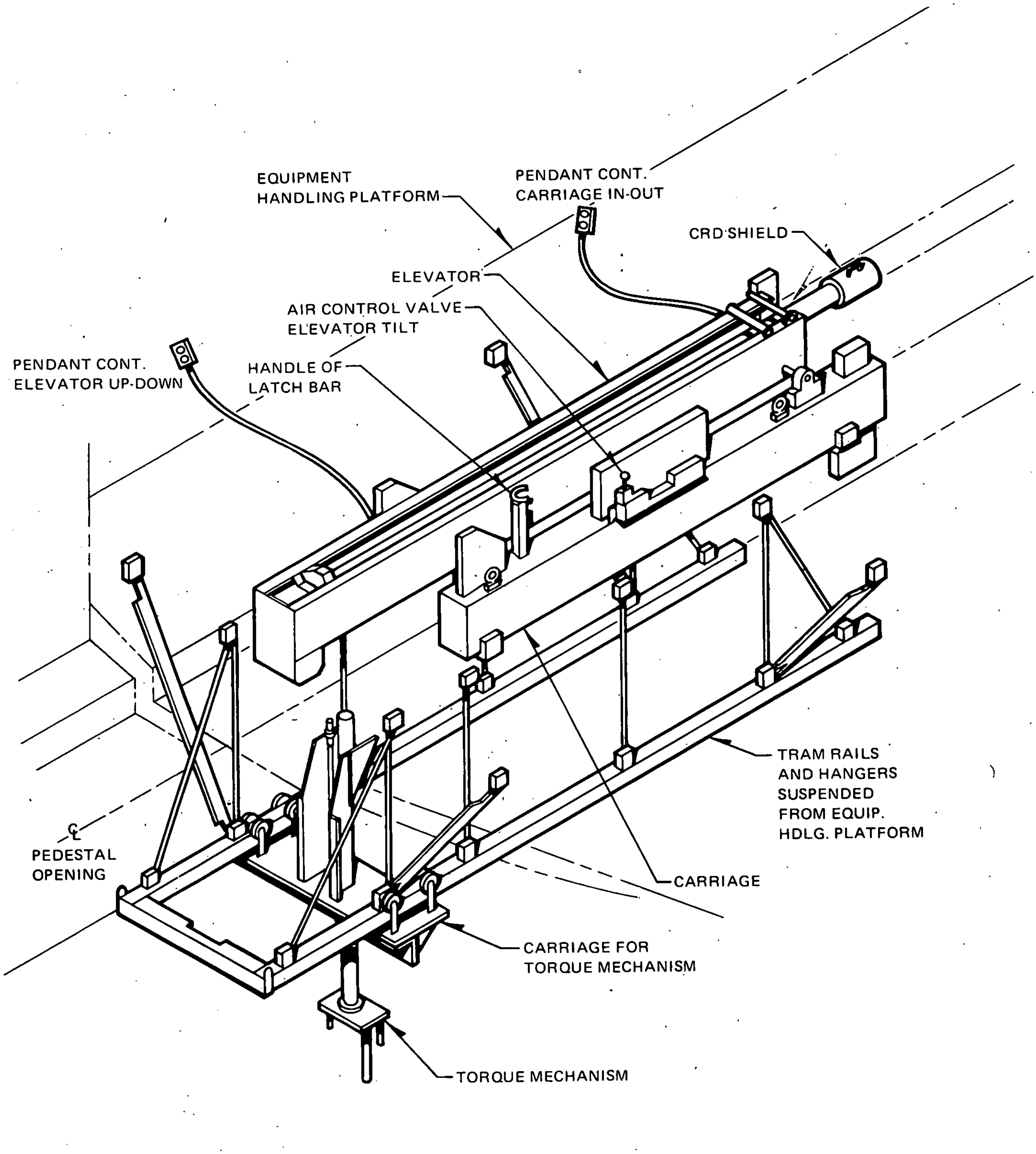


Figure 5-1. CRD Handling Equipment

5.6 REACTOR PRESSURE VESSEL NUT REMOVAL TOOLING

Design and fabricate a power-operated reactor pressure vessel nut removal tool. The tool would mate with the castellated nuts, would be compatible with the new carousel and would incorporate a lifting device for transfer of the nuts to and from the nut storage rack. (16 hours)

5.7 SERVICE LINE CONTROL

The objective is to prevent outage delays caused by fouling of service lines (air, water, electrical, etc.) during in-vessel and under-vessel work. This would be accomplished by developing a device that could effectively control all service leads. It would be suitable for rotating platforms also. This device would be a type of commutating mechanism permitting neatly arranged input lines and wires and easily managed and dispensed outlets. (4 hours)

5.8 RAPID ENGAGEMENT HEAD SPRAY LINE CONNECTION (Figure 5-2)

The objective is to reduce the time required for bolting and unbolting the head spray piping flanged joints. This modification requires design stress analysis and installation of a quick disconnect coupling into the head spray, instrument and vent lines. (12 hours)

5.9 BACK-FIT BWR-6 REFUELING PLATFORM

The objective is to improve refueling platform reliability. The BWR-6 platform incorporates the latest state-of-the-art electrical and mechanical improvements. When compared to a modification program to upgrade the existing refueling platform, the BWR-6 back-fit yields better results at a lower cost. (40 hours)

5.10 REACTOR PRESSURE VESSEL HEAD TENSIONING/DETENSIONING IMPROVEMENTS

1. Newly designed RPV head carousel strongback with eight power engagement drive-tensioners.

2. Nut storage rack for removing nuts from the cavity.

3. Incorporate some aspects of service line control (Recommendation 5.7). (40 hours)

5.11 LOOSE PARTS PREVENTION PROGRAM (Figure 5-3)

Develop a loose parts prevention program consisting of the design, fabrication, and assembly of a guard or screen system to cover the vessel opening to catch dropped objects. The screen would be supported from the RPV shroud or wall, would have a remotely operated panel system, and permit loading and unloading fuel and selected core components and also permit normal inspections. (48 hours)

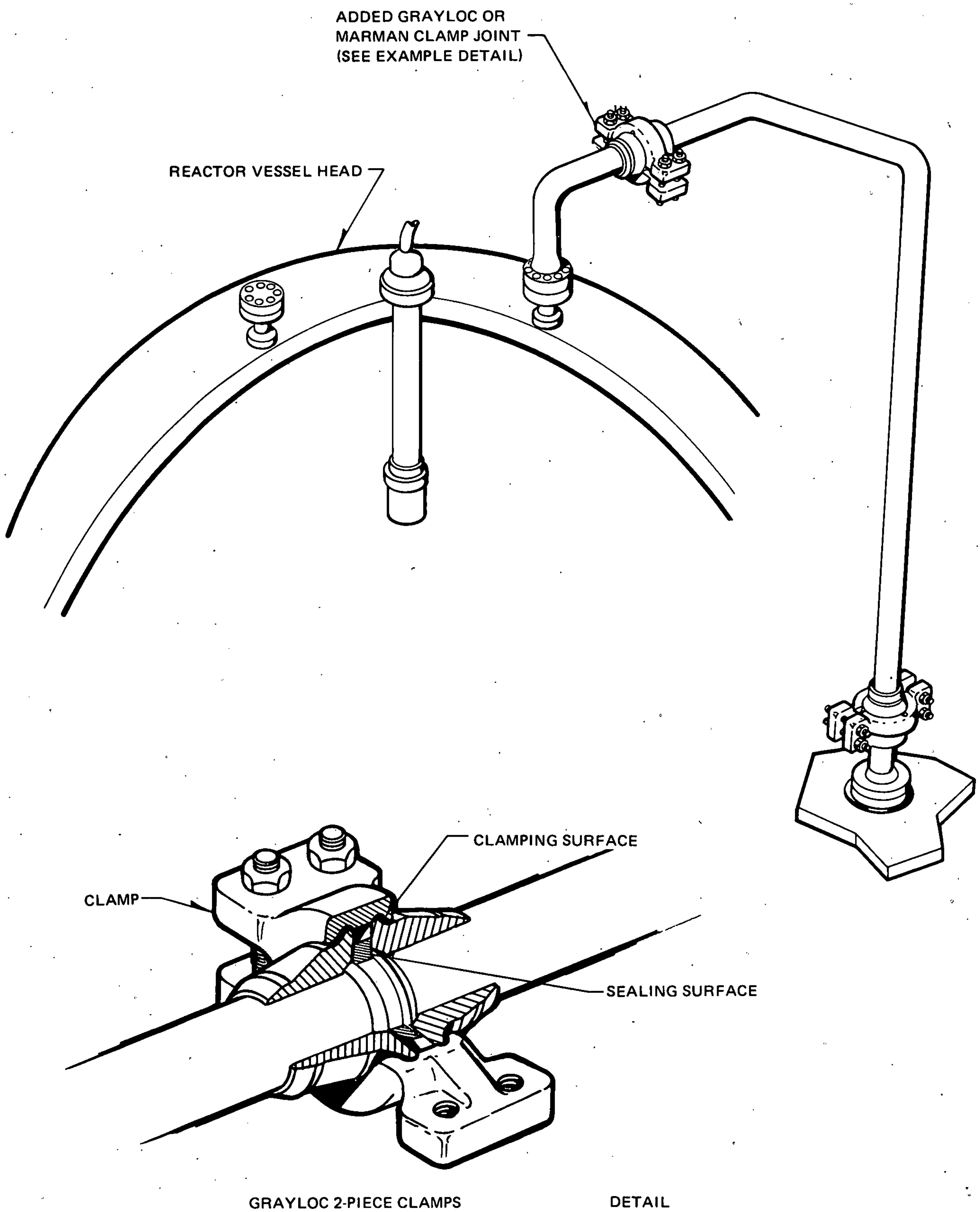


Figure 5-2. Rapid Engagement Head-Spray Line

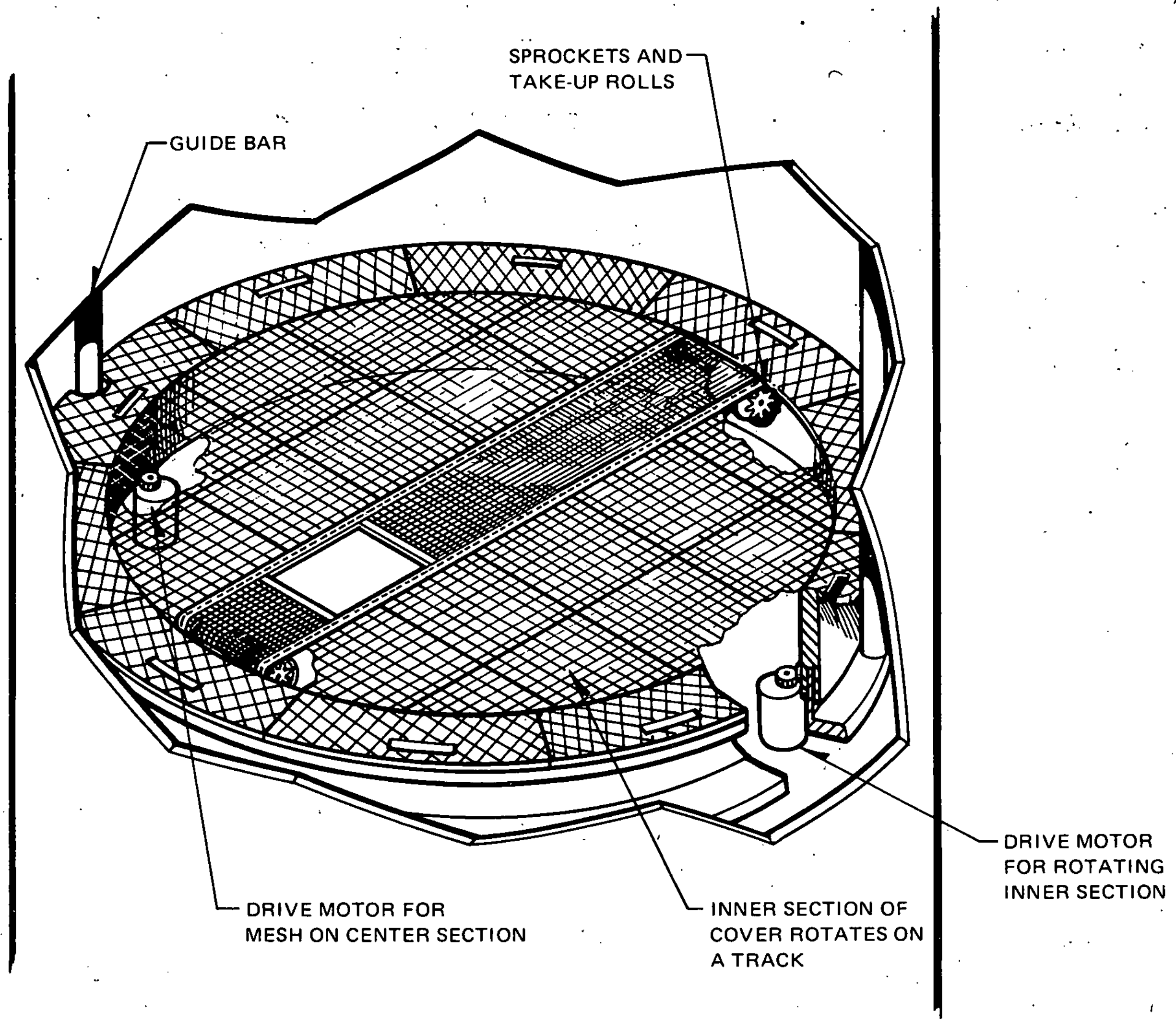


Figure 5-3. Loose Parts Prevention

5.12 DEVELOP MINIMUM PASS TENSIONING/DETENSIONING SEQUENCE

Develop a tensioning sequence requiring the minimum possible number of steps. This improvement requires the development and analysis of a generic mathematical model of the RPV stud/flange arrangement and instrumented tensioning testing to verify the results. (13 hours)

5.13 REACTOR PRESSURE VESSEL STUD THREAD LUBRICANT APPLICATION

This program consists of the development of an air-driven rotating applicator with pressurized lubricant feed and integral reservoir. It would be a compact, light, enclosed unit which applies a metered, thin coating. In addition to the time savings projected for its initial use, it would also reduce the time required for subsequent thread cleanup cycles, since thorough cleaning and reapplication is required, and reduce the probability of binding during nut removal. (2.5 hours)

5.14 LOOSE PARTS RETRIEVAL PROGRAM

Develop an underwater retrieval tooling package consisting of:

1. Light sources of sufficient intensity and quality to illuminate any area of interest.

2. Viewing apparatus consisting of fiber optics suited for radiation environment provided with 50-mm focal length and 80-degree viewing angle lense. (Signal attenuation has been estimated at 12% for direct viewing.) A signal intensifier with TV monitor (possibly) with a bend radius of 1-3/4 inches, right angle viewer, and other accessories should be supplied so that the grapple is observable during operation.

3. Retrieving mechanism providing access into a 5 by 5-inch cross section access, into and behind a jet pump diffuser, and sufficient maneuverability to read all areas of the lower core plate and shroud annulus. The mechanism may have a neutral buoyancy and may be remotely operated in conjunction with a television monitor.

   This program is considered essential in addition to loose parts prevention (5.11) since the screen cannot be in place all the time that the RPV head is removed (e.g., dryer and separator removal and replacement). (45 hours)

5.15 REACTOR CAVITY ELEVATOR (Figure 5-4)

The objective is to improve personnel safety and work area accessibility and thus reduce tool/man transport time into the cavity while freeing the building crane in many cases. The equipment would consist of a portable lift with special requirements of close ground clearance, easy decontamination, and secured component parts. (15 hours)

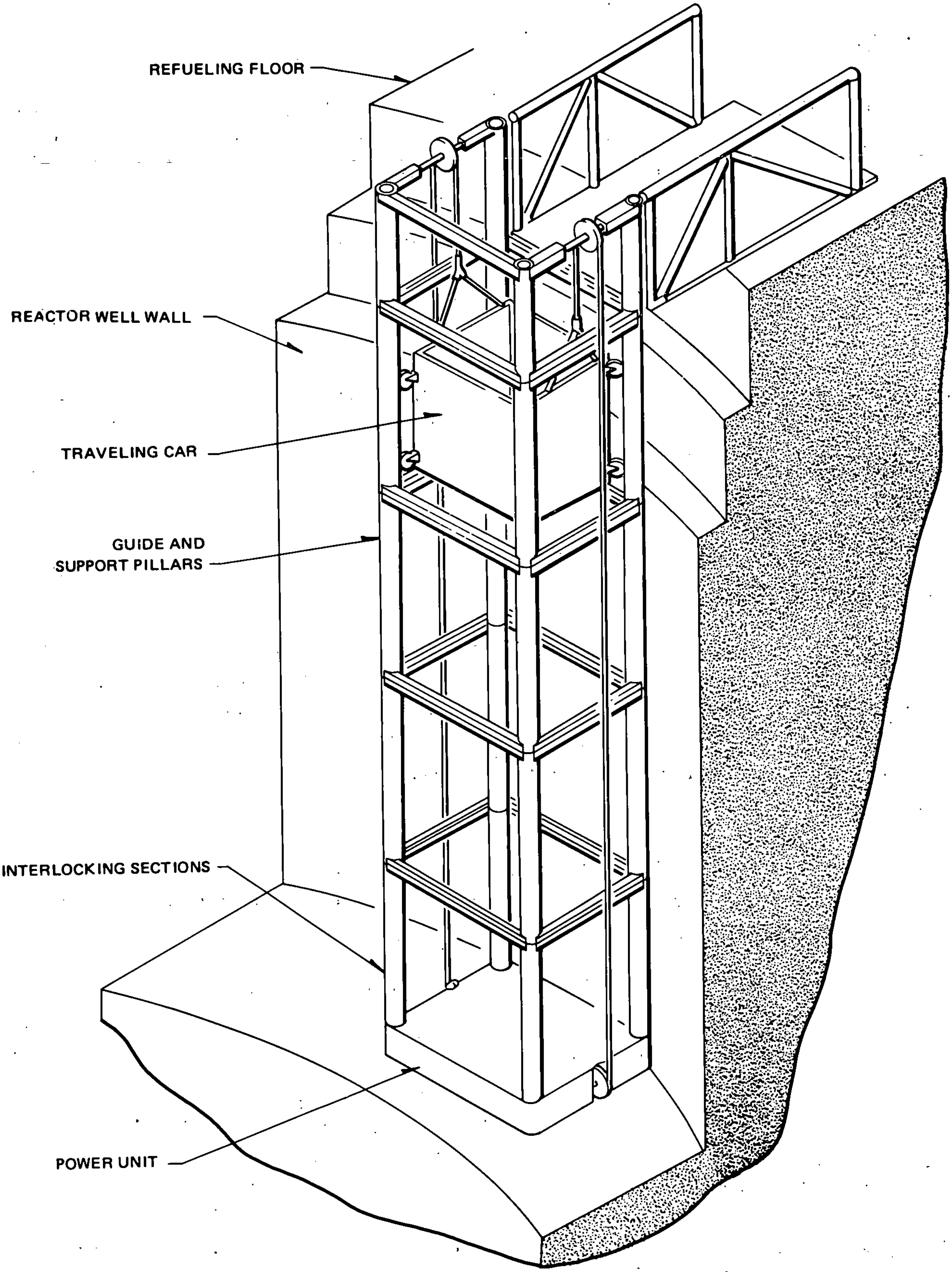


Figure 5-4. Reactor Cavity Elevator

5.16 COMMUNICATIONS

Develop a communications system to improve the ability to manage, control, and organize the outage activities on the refueling floor, reactor cavity, and drywell. The system will utilize headset, radio transceivers, portable television monitors to provide communications between the drywell, reactor cavity and control room, and area control points to monitor fuel movement, undervessel maintenance, and maintenance in high radiation areas. A development effort to design and specify a remotely controlled underwater camera is also included. (24 hours)

5.17 DECONTAMINATION EQUIPMENT (Figure 5-5)

The objective is to develop a semiautomatic method to decontaminate the reactor cavity and vessel walls. Hydrolasing of the vessel walls reduces the contamination level by a factor of up to 600. A semiautomatic process could in some cases save up to 48 hours with an average of 8 hours per outage as well as reducing exposure rates significantly. (8 hours)

5.18 MULTIPLE LPRM HANDLING STRONGBACK (Figure 5-6)

The objective is to develop a complete LPRM handling system. The development of an integral system compatible with the shipping container and insertion tool is proposed. This system would include a strongback with storage capacity for all LPRMs to be installed at the same time. Such a system would not only minimize time but would also free the building crane by requiring only one move to handle all LPRMs to be replaced. (7 hours)

5.19 REACTOR PRESSURE VESSEL RECIRCULATION OUTLET NOZZLE DEBRIS SCREENS (Figure 5-7)

The objective is to provide a quick and economical method to remove some types of debris from the reactor vessel. These screens should be easily installed and removed to assure a minimum of lost downtime. (4 hours)

5.20 REACTOR PRESSURE VESSEL RECIRCULATION OUTLET NOZZLE PLUGS (Figure 5-8)

These plugs would provide isolation of the recirculation lines against the static head of water in the reactor vessel. This would allow more timely maintenance of the recirculation pump suction valves and it would no longer be necessary to drain the annulus around the core barrel to accomplish this work. (4 hours)

5.21 MAIN STEAM LINE PLUG HOLDER

The development of this tool would permit testing of the MSIVs in the direction of flow which aids the positive seating of the valve. The intent is to prevent false leakage readings, and thus needless maintenance work on the valves, which is thought to sometimes occur with the current testing method. It would also allow

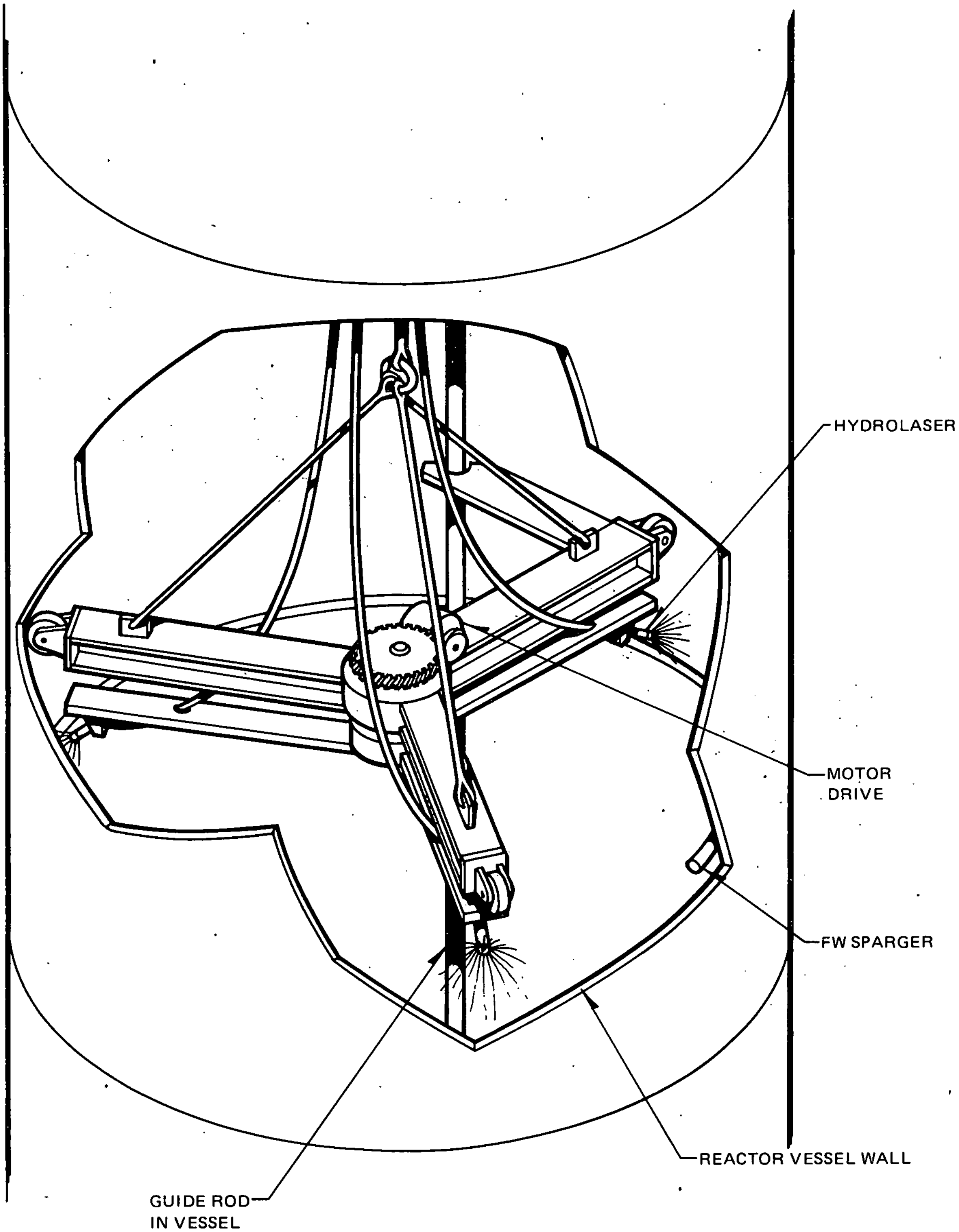


Figure 5-5. Remote Hydrolaser Decontamination Device

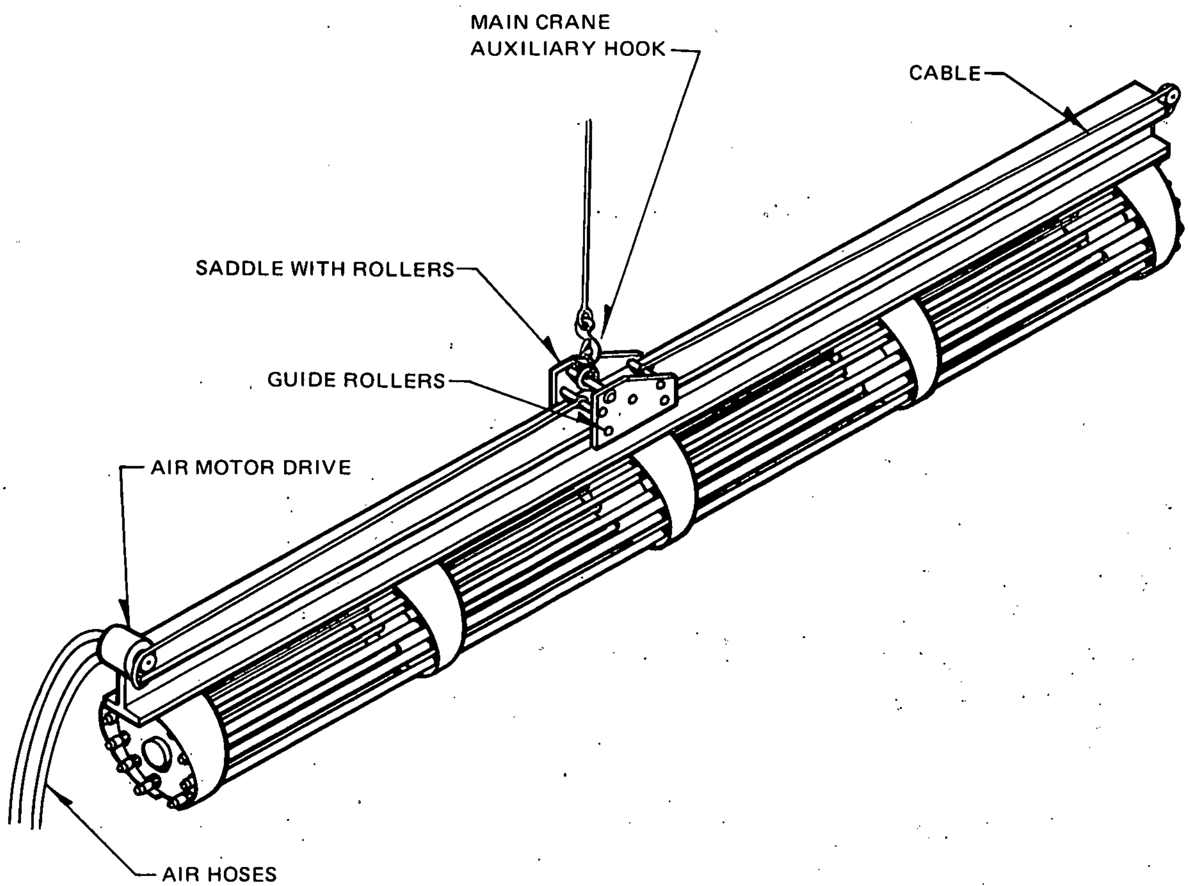


Figure 5-6. Multiple LPRM Handling and Rotating Strongback

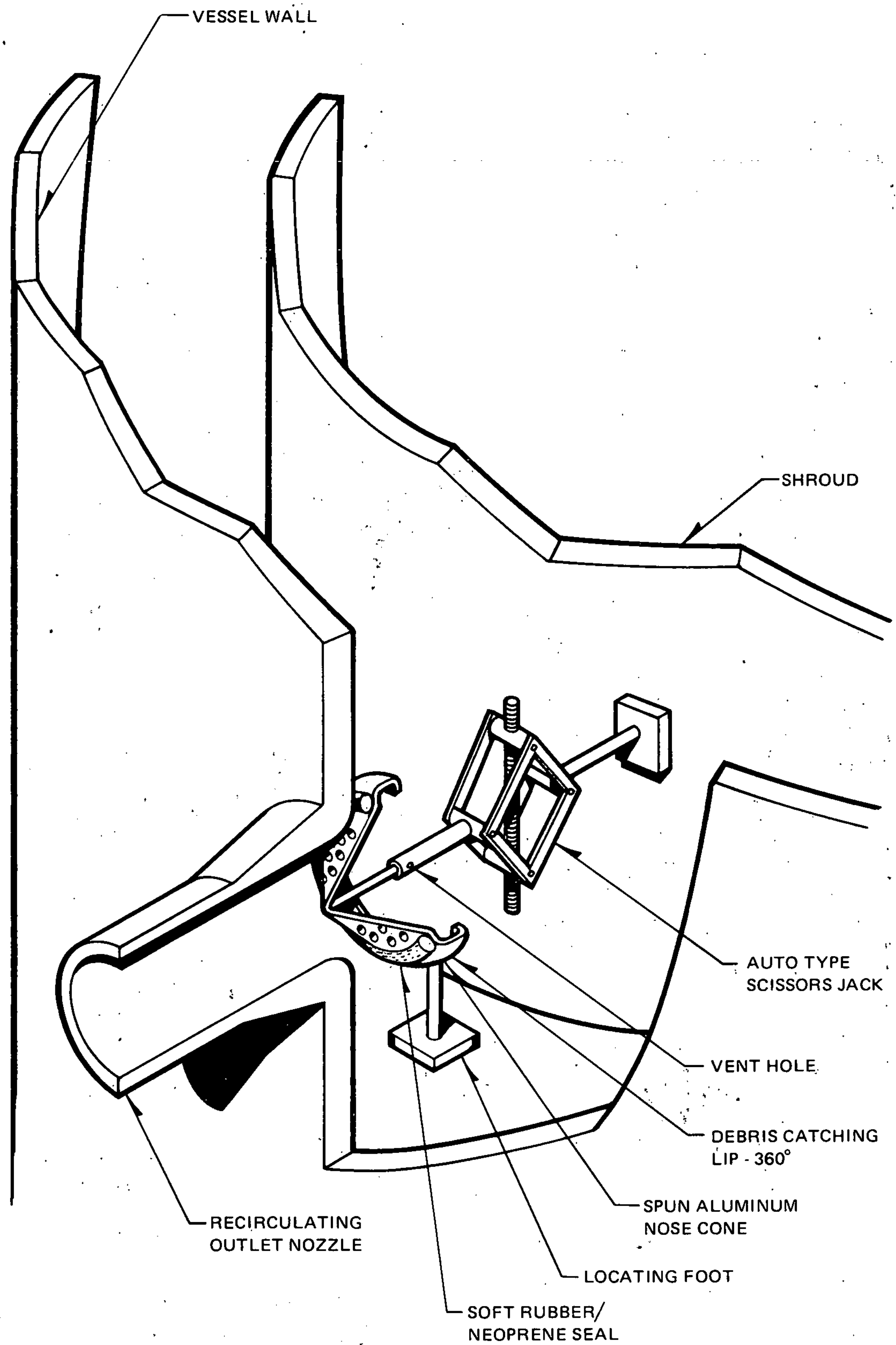


Figure 5-7. Recirculation Line Screen

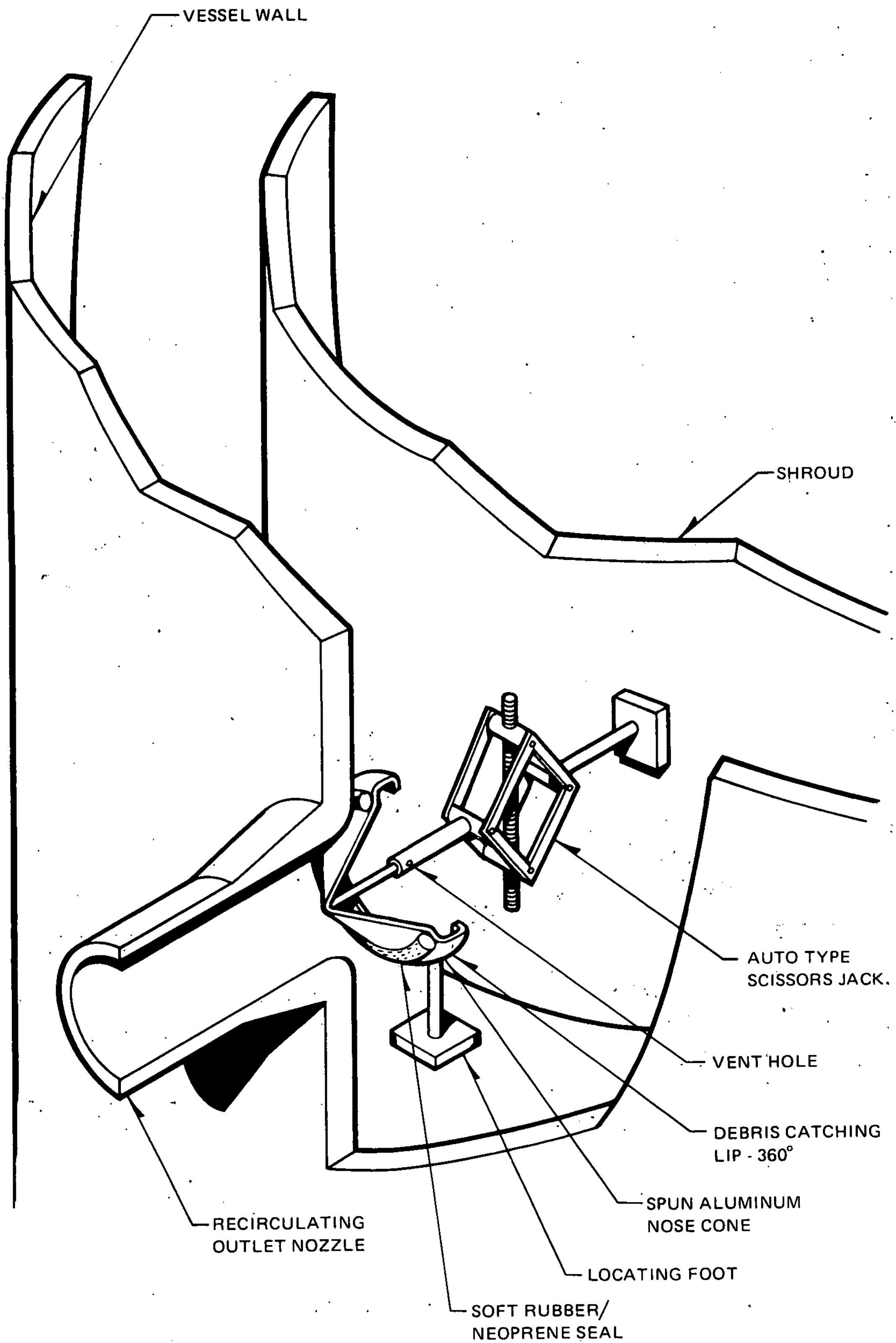


Figure 5-8. Recirculation Line Plug

these tests to be conducted without interference with other reactor activities. This holder is a tubular ring that is lowered into the RPV on the guide bars. It has four plugs that are power inserted into the steam lines, in the same position as the existing plugs. This ring and the new plugs are designed to withstand MSIV leak test pressure while permitting in-vessel work. (4 hours)

5.22 OPTICAL POSITIONING OF REFUELING PLATFORM GRAPPLE

The objective is to provide capability for service platform-mounted grappling devices to be automatically positioned at any coordinate without intermediate pauses or stops and within required positioning tolerances. This could be accomplished by means of a laser beam signal reflecting from an accurately located datum. (24 hours)

5.23 IMPROVE ROTATING PLATFORM DRIVES

The objective is to reduce outage time by increasing efficiency during items worked from the service platform and the under-vessel platform. The existing platform drives would be improved in the following areas: (1) precision of tracks and wheels, (2) control and smoothness of operation, and (3) sufficient power to overcome minor frictions and bindings, thereby eliminating the need for manual assisting. (1 hour)

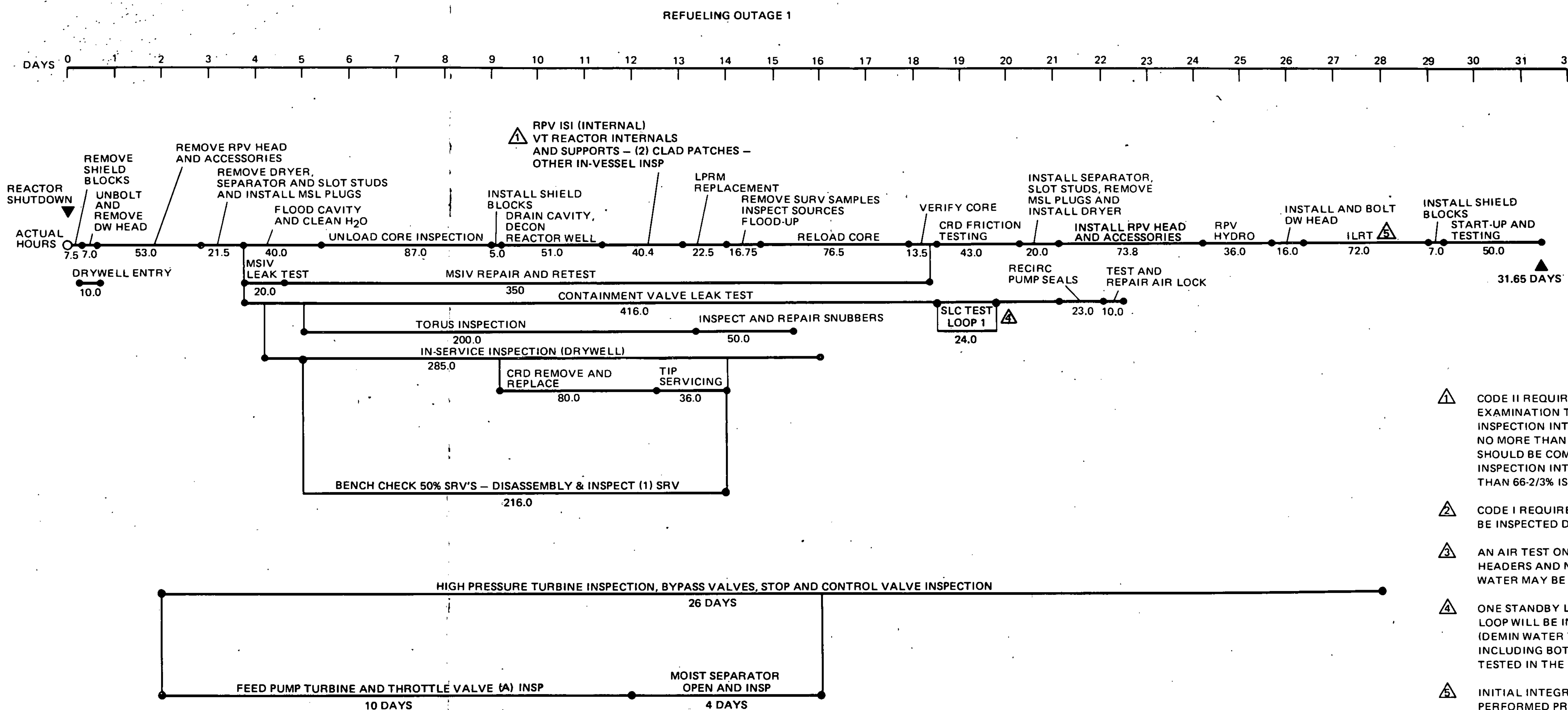
6. TEN-YEAR OUTAGE SCHEDULE

The main objective of this DOE program is to improve nuclear plant availability. One method to aid in meeting this objective is to utilize long-range planning. By setting up a 10-year outage schedule, in service inspection (ISI) can be scheduled to meet the 10-year code requirements, and preventive and periodic maintenance can be scheduled to better utilize outage time and available manpower.

Figure 6-1 is a 10-year schedule for the demonstration plant, Browns Ferry 1. The first annual refueling outage is based on current activity duration experiences for normal, recurring activities. One-time only and nonrecurring activities are not included in this schedule. For the first year, therefore, an optimized, "typical" 32-day outage is depicted (see Section 7 for a detailed description of the "typical" schedule).

For the purposes of this 10-year schedule it is assumed that the recommendations of this section are incorporated in 3 years and, therefore, for the 4th through 10th years the "ideal" outage schedule is used.

This projected schedule for a 10-year program assumes 10 annual refueling outages. Should a power station change to an 18-month operating cycle, the planning would have to be shifted accordingly.



NOTES

1. CODE II REQUIRES THAT 25% OF THE REQUIRED EXAMINATION TO BE COMPLETE AFTER 1/3 OF THE INSPECTION INTERVAL (10 YEARS). CREDIT FOR NO MORE THAN 33-1/3% IS GIVEN. FIFTY PERCENT SHOULD BE COMPLETE AFTER 2/3 OF THE INSPECTION INTERVAL. CREDIT FOR NO MORE THAN 66-2/3% IS GIVEN

2. CODE I REQUIRES THAT ALL AREAS OF INTEREST BE INSPECTED DURING THE INSPECTION INTERVAL

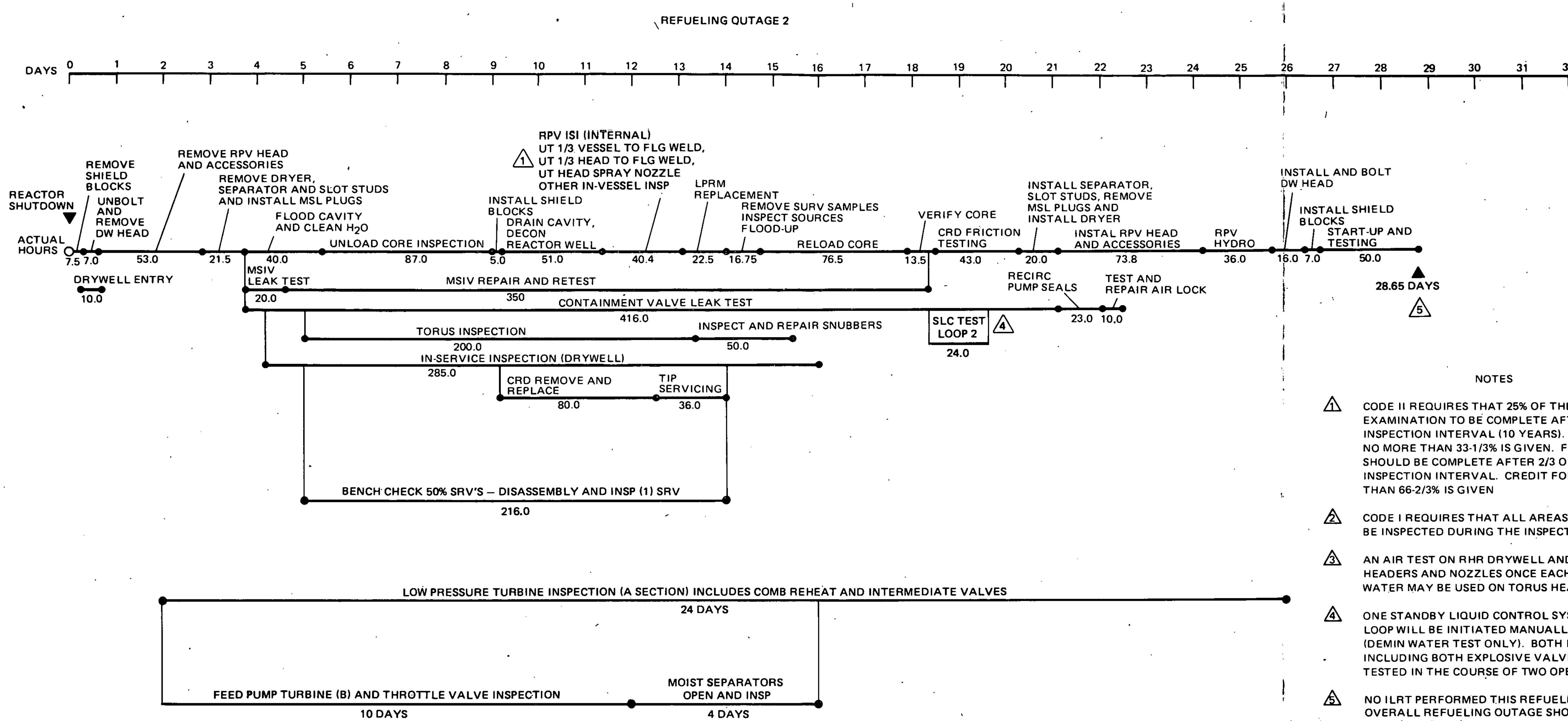
3. AN AIR TEST ON RHR DRYWELL AND TORUS HEADERS AND NOZZLES ONCE EACH 5 YEARS. WATER MAY BE USED ON TORUS HEADER

4. ONE STANDBY LIQUID CONTROL SYSTEM (SLCS) LOOP WILL BE INITIATED MANUALLY EACH OUTAGE (DEMIN WATER TEST ONLY). BOTH LOOPS, INCLUDING BOTH EXPLOSIVE VALVES SHALL BE TESTED IN THE COURSE OF TWO OPERATING CYCLES

5. INITIAL INTEGRATED LEAK RATE TEST (ILRT) IS PERFORMED PRIOR TO INITIAL OPERATION. ILRT'S ARE THEN PERFORMED AT APPROXIMATELY 3-1/3-YEAR INTERVALS TO EQUAL (4) ILRT OVER 10-YEAR PERIOD. LLRT'S MUST PRECEDE ILRT

6. PRIMARY NOZZLES 4 INCHES AND LARGER AND INCLUDES:
   a. UT OF VESSEL-TO-NOZZLE AND INSIDE RADII
   b. VT, PT, UT NOZZLE TO SAFE END

Figure 6-1. Ten-Year Schedule for Demonstration Plant



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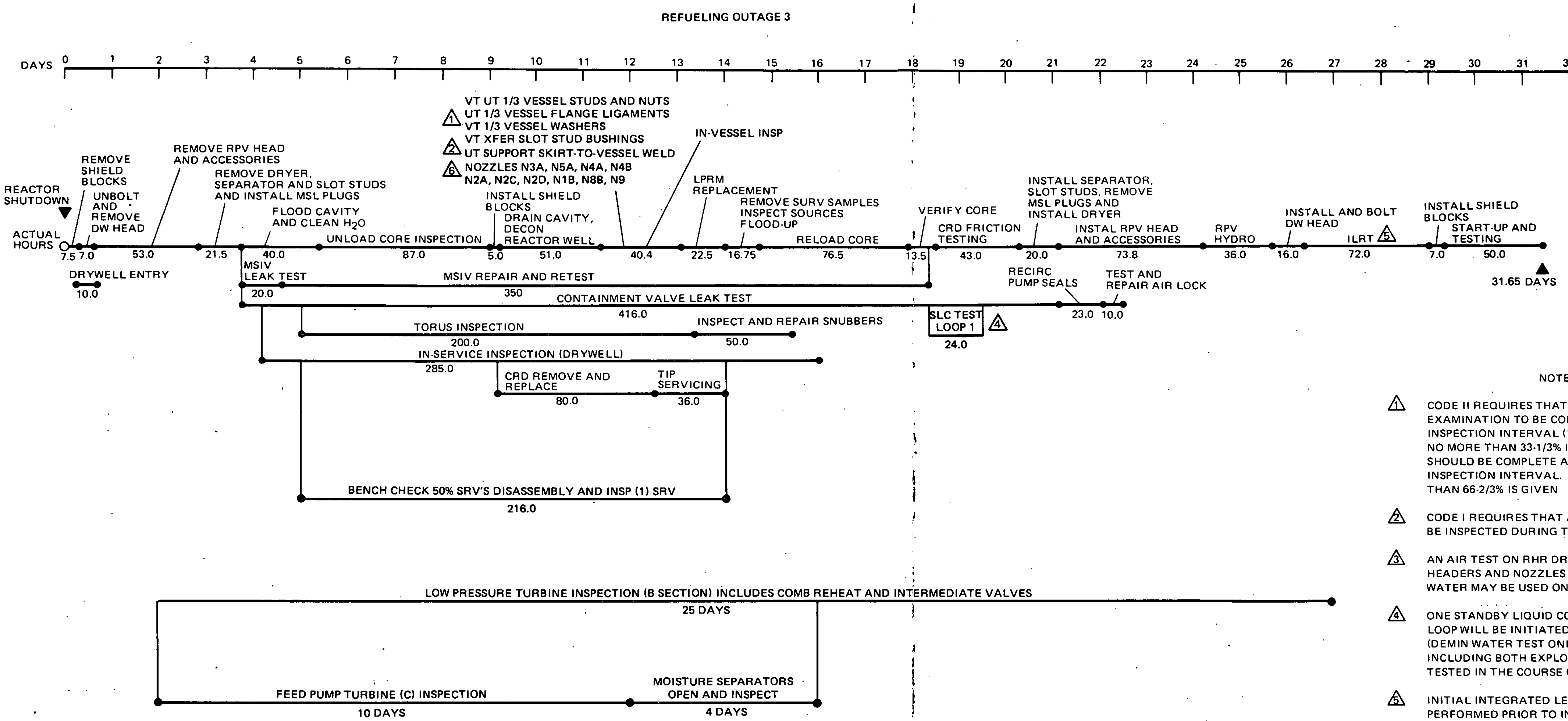
5. NO ILRT PERFORMED THIS REFUELING OUTAGE. OVERALL REFUELING OUTAGE SHORTENED 3 DAYS (72 HOURS)

6. PRIMARY NOZZLES 4 INCHES AND LARGER AND INCLUDES:
   a. UT OF VESSEL-TO-NOZZLE AND INSIDE RADII
   b. VT, PT, UT NOZZLE TO SAFE END

Figure 6-1: Ten-Year Schedule for Demonstration Plant (Continued)



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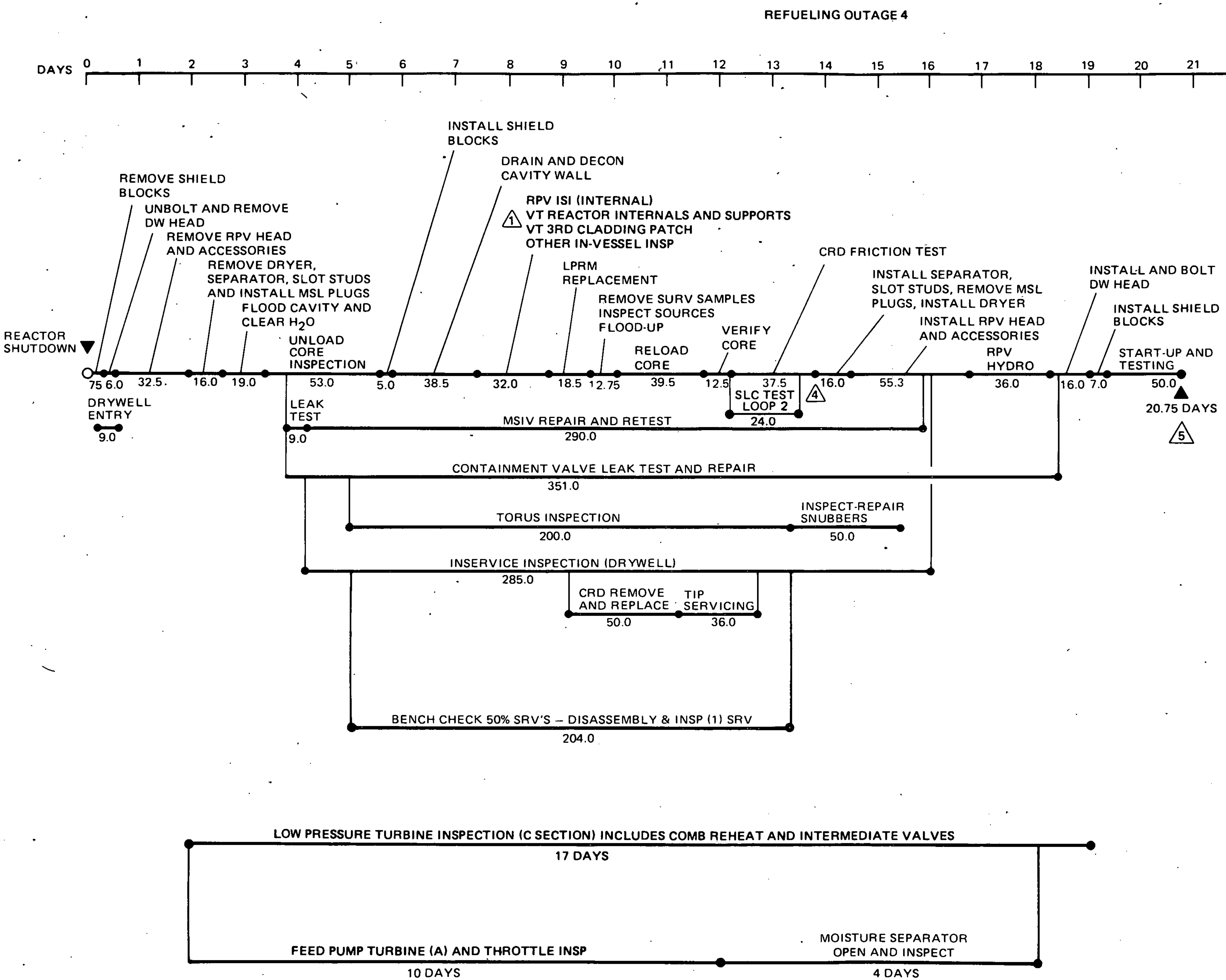

NOTES

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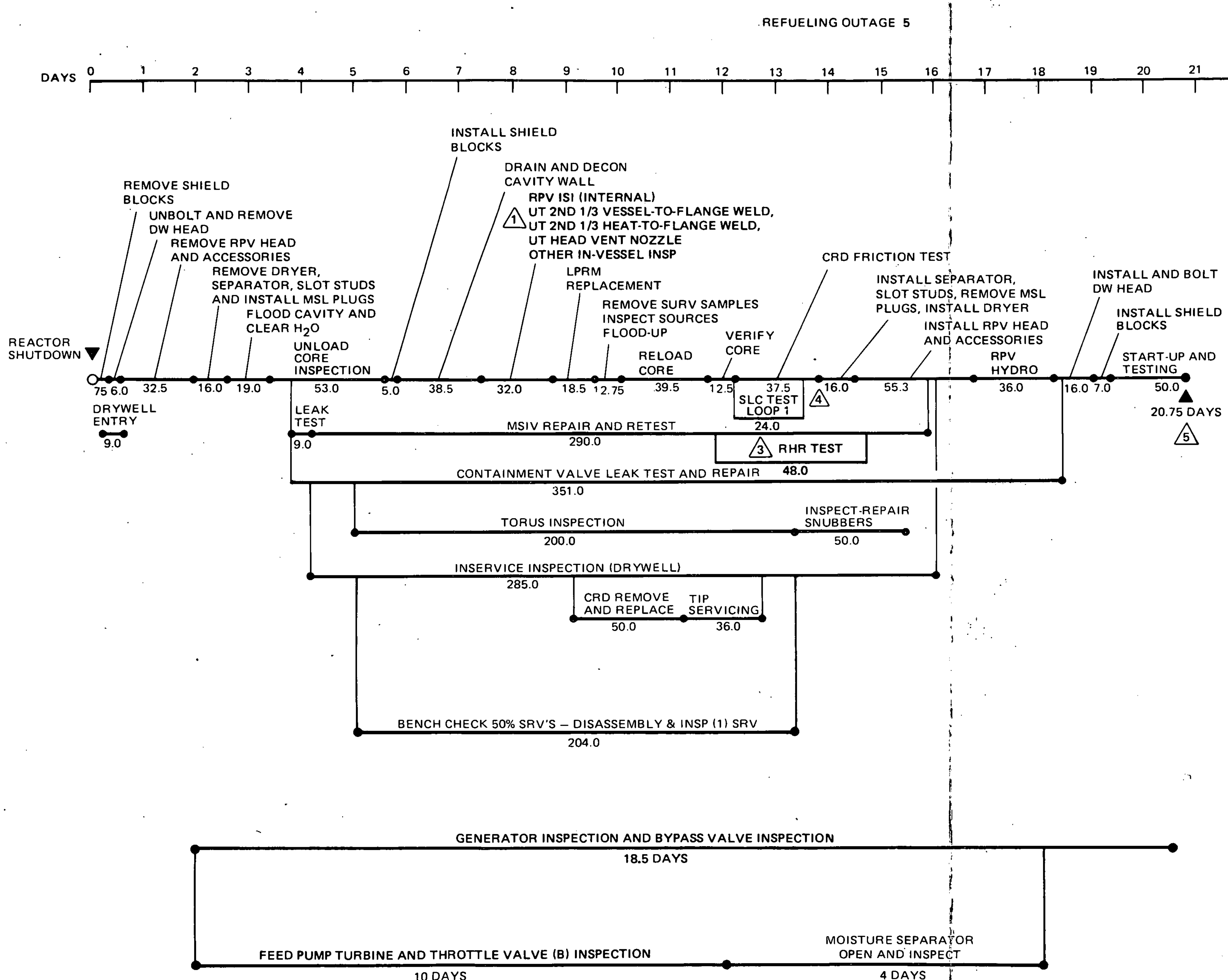
Figure 6-1. Ten-Year Schedule for Demonstration Plant (Continued)



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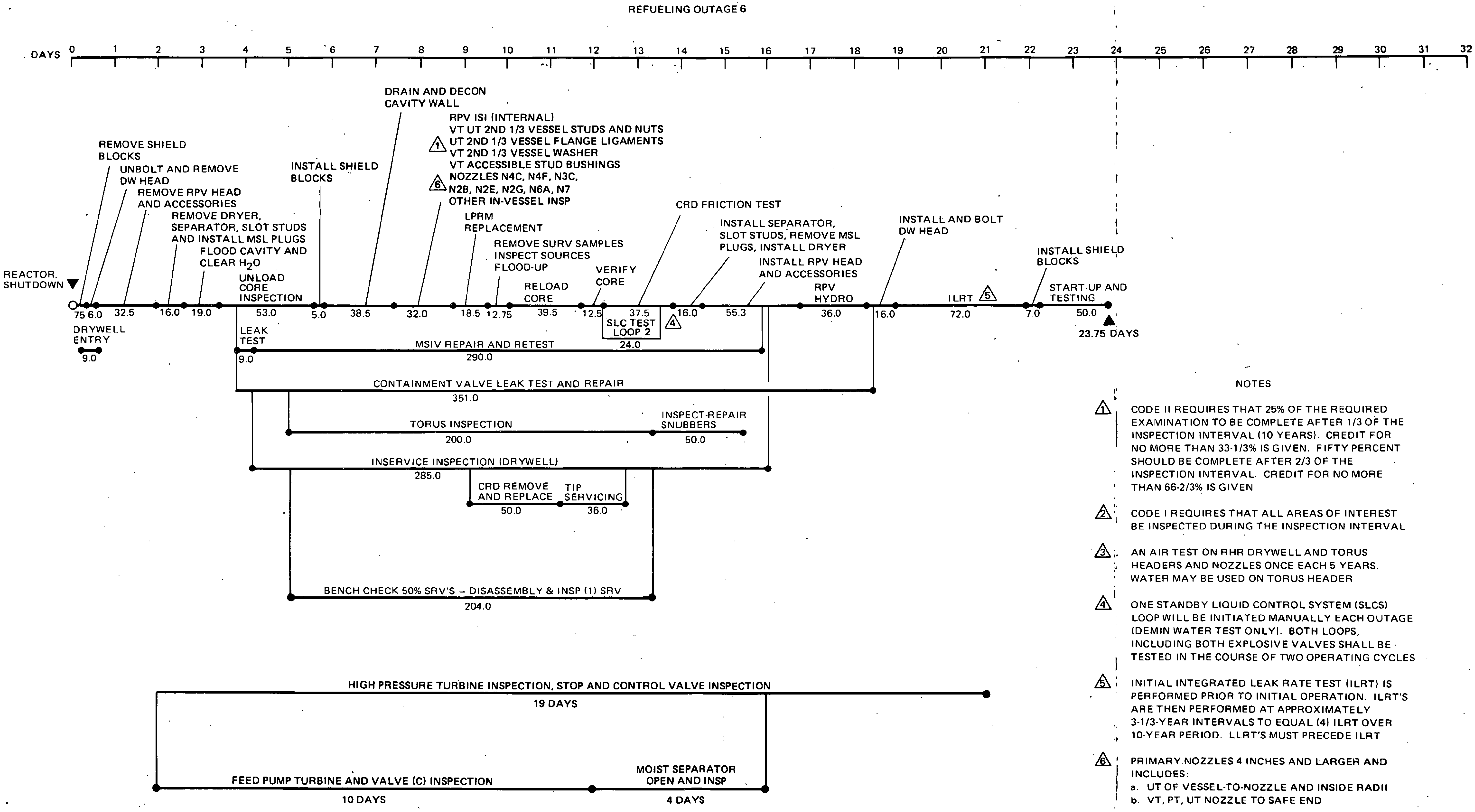

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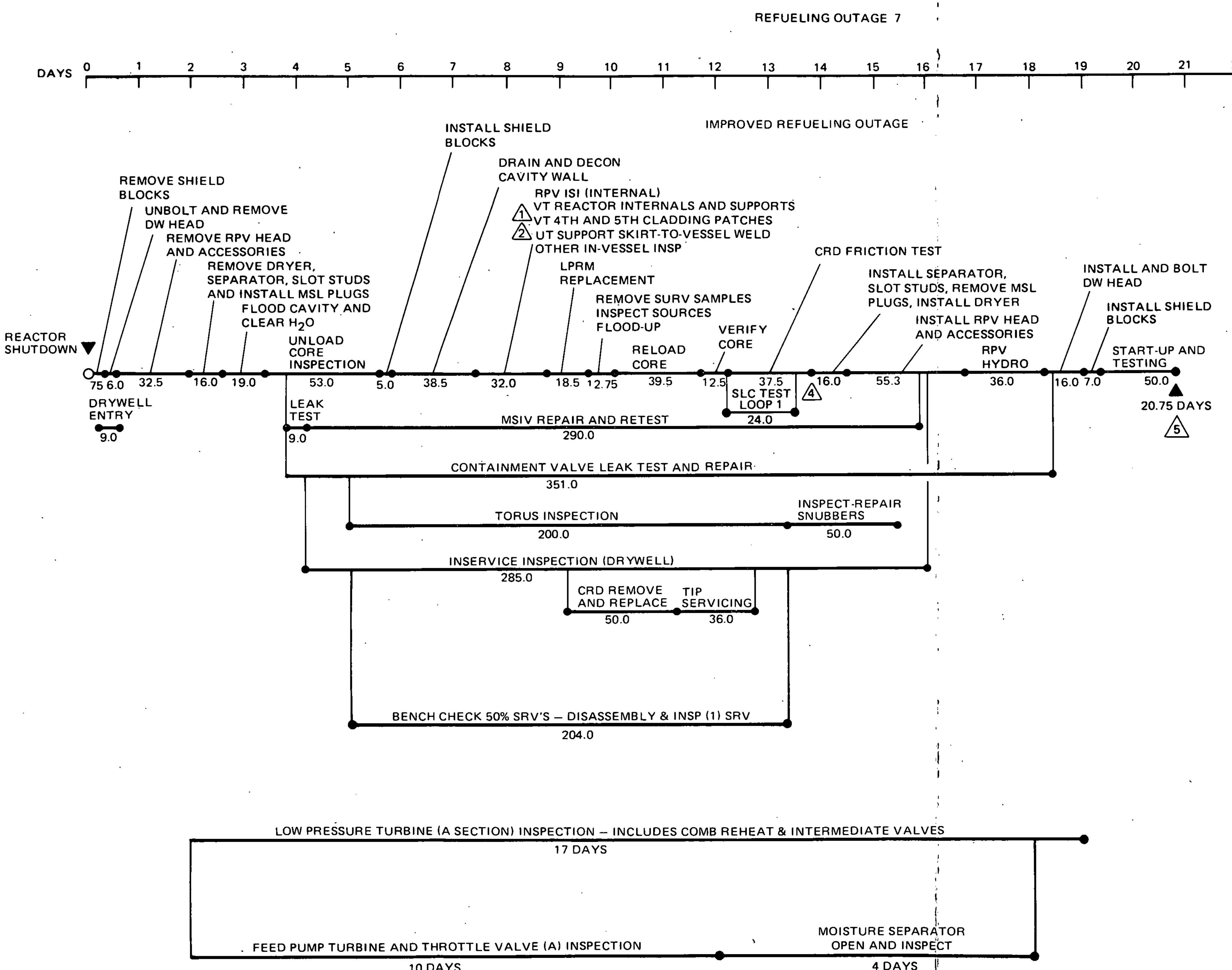

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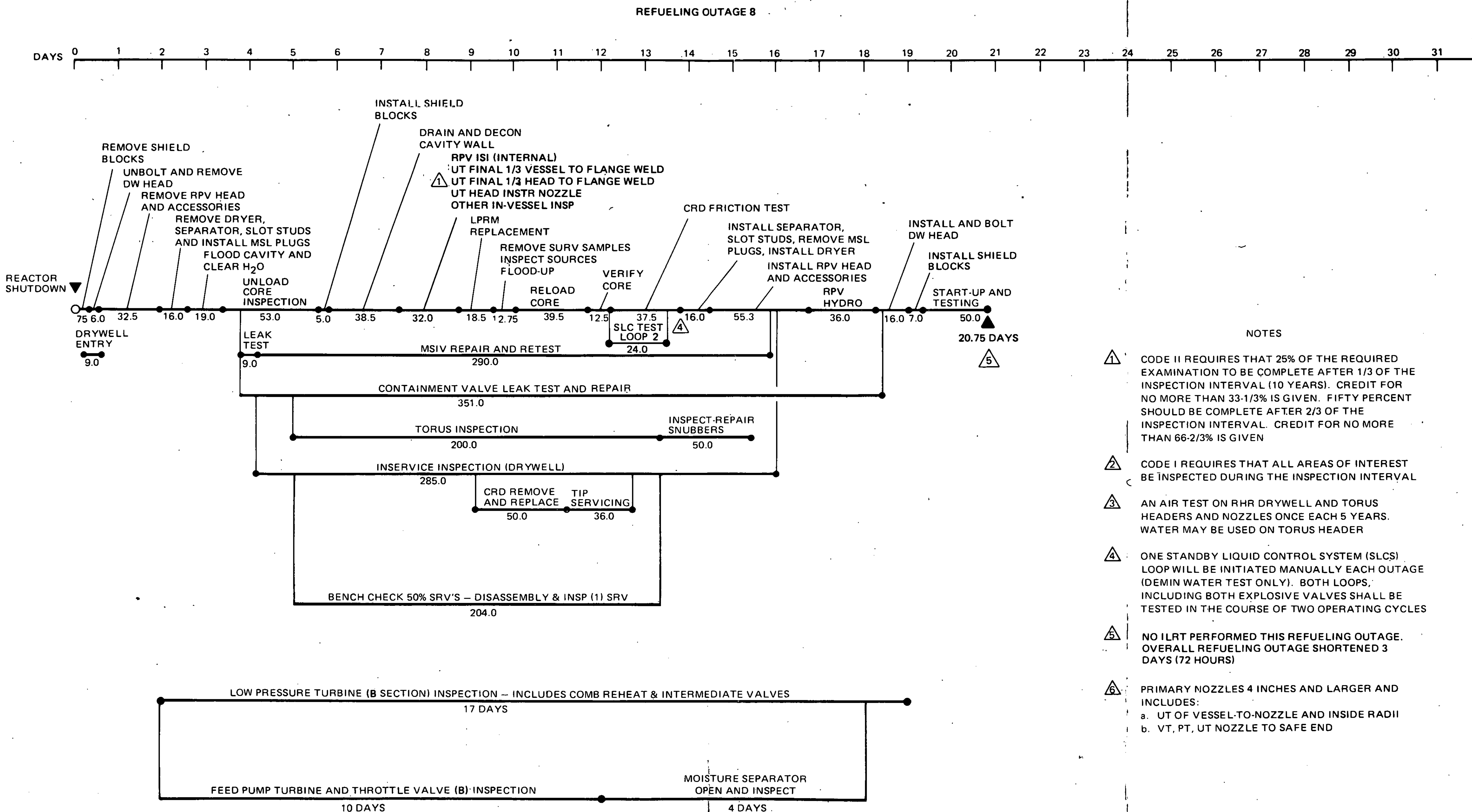

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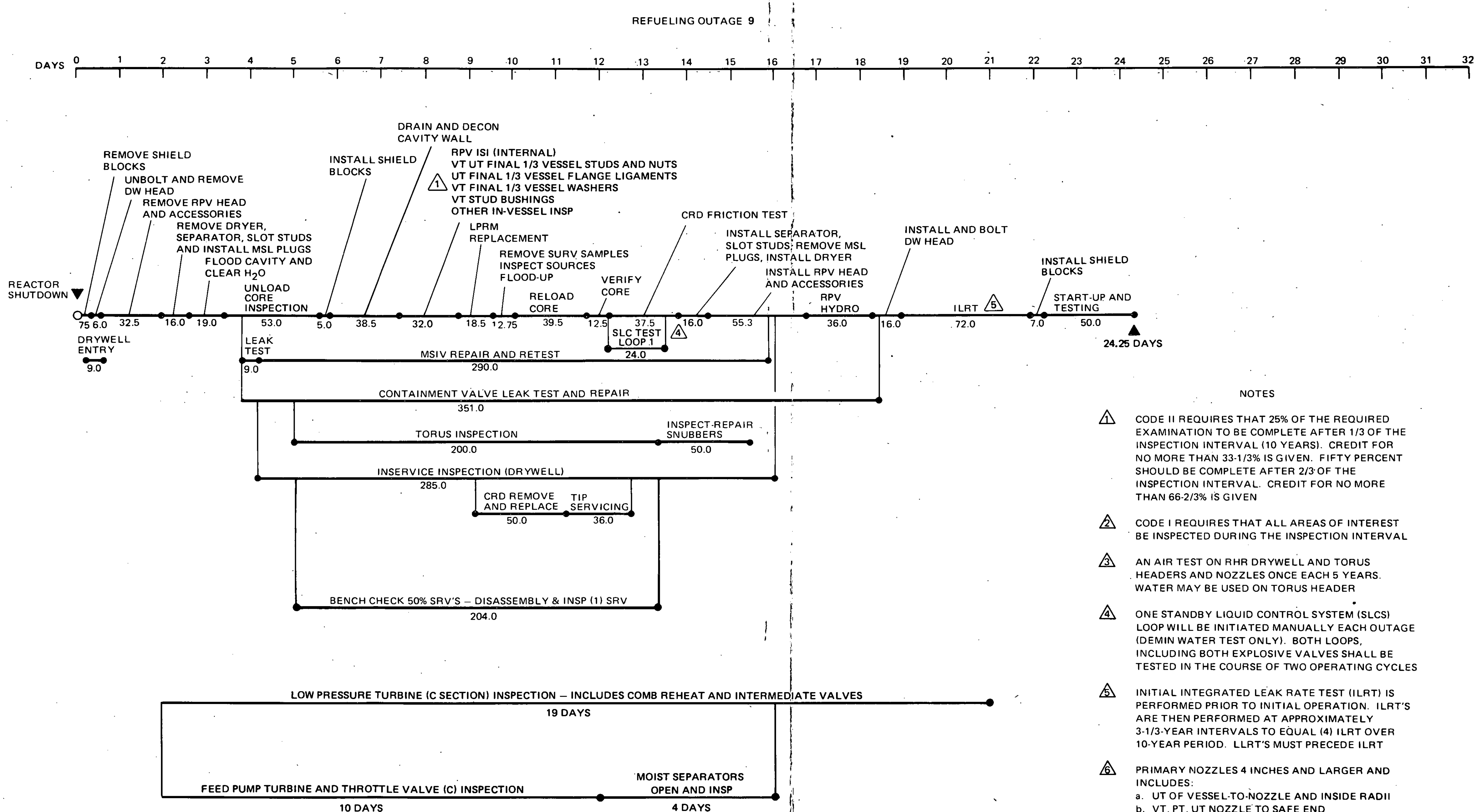

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Figure 6-1. Ten-Year Schedule for Demonstration Plant (Continued)

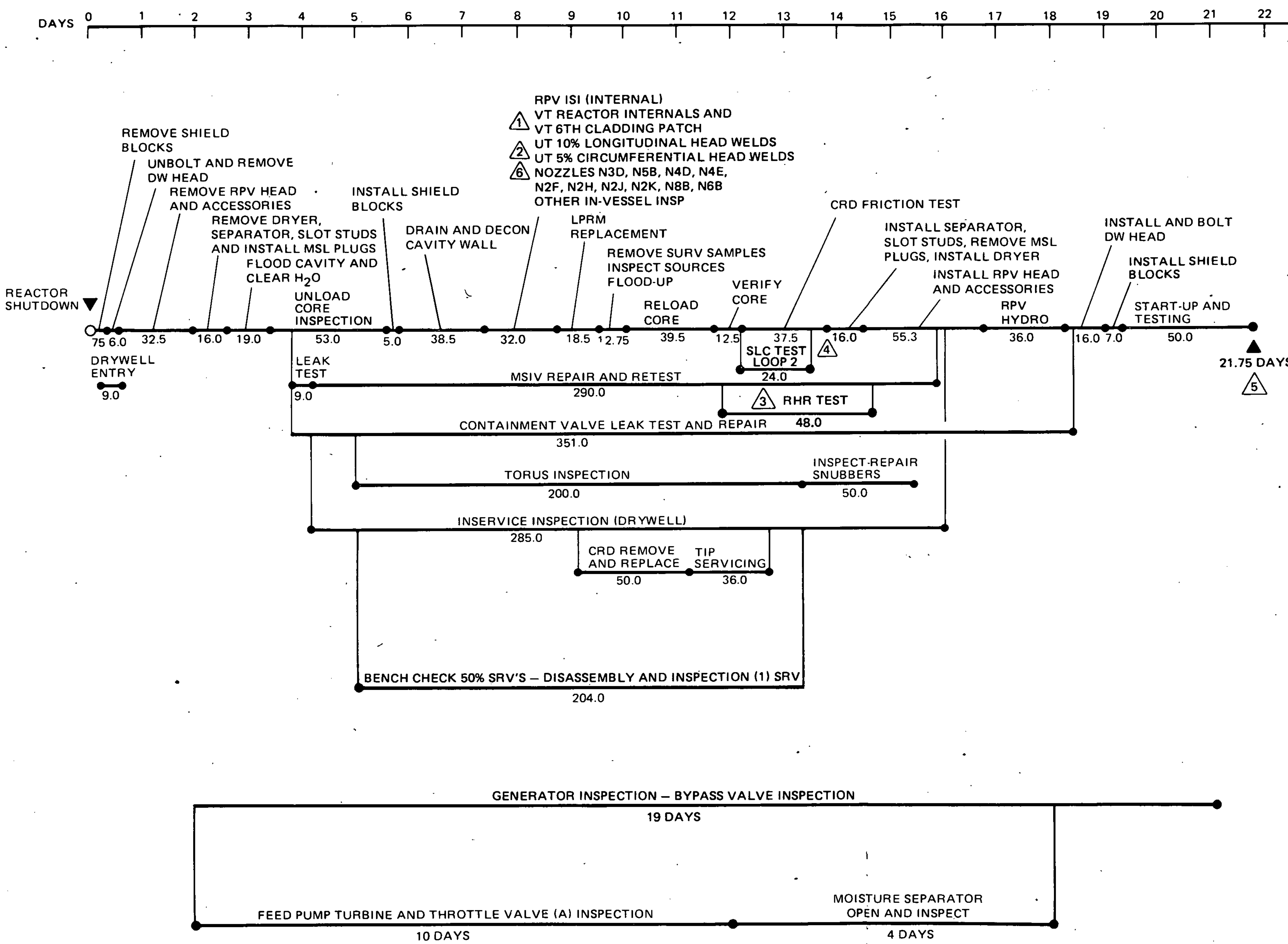

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Figure 6-1. Ten-Year Schedule for Demonstration Plant (Continued)

7. SUMMARY OF POTENTIAL BENEFITS

Recommendations pertaining to equipment, procedural, and design changes are listed in Sections 3, 4, and 5 of this document. Significant benefits can be realized by implementing these recommendations. This reduction in the refueling outage duration improves plant availability and results in economic benefits to the utility and their customers.

Several of the recommendations are not directly or fully related to outage critical path time since they reflect changes to parallel activities (parallel to critical path time). However, these items can reduce manpower requirements, man-Rem exposures and contribute positively in many other ways.

Since all outages are essentially controlled by the critical path time schedule, this section will deal mostly in this area. Potential benefits will be fit into the schedule, resulting in a reduction in overall outage critical path time.

The Potential Benefit Analysis (Table 7-1) is a list of improvement recommendations that can be used to reduce outage times. The table shows the estimated time savings that could be realized for critical path and noncritical path time schedules as well as the man-Rem reductions.

Table 1-2 summarized the critical path analysis. The Browns Ferry 1 Fall 1977 refueling outage was originally planned to take 78 days. The actual outage took 126 days. For the purposes of this critical path benefit analysis a "typical" outage schedule was utilized. No nonrecurring or one-time activities were scheduled. Also, only one-third of the core is removed, sipped, and replaced, one-third of the LPRMs replaced, and 10% of the CRDs replaced. No margin was included for unplanned delays or other problems (i.e., activities, start and end on time, and everyone knows what to do, etc.,). This "typical" schedule of approximately 32 days is, then, the starting point for this critical path analysis.

It should be noted that a reduction of 57.5 days is assumed from the average BWR outage in 1977 (Table 1-1) of 89.4 days in arriving at the "typical" refueling outage starting point of this section. This is theoretically accomplished by making the eliminations discussed above.

The recommendations of Sections 3, 4, and 5 are then listed in Table 7-1 with associated time savings. Table 7-2 categorizes these savings by each refueling outage activity contained in the "typical" schedule. Finally, these savings are applied to the "typical" outage activities resulting in the "ideal" refueling outage of Figure 7-1.

In conclusion, the "ideal" refueling outage of about 24 days (23.75) is achievable by implementing the recommendations of this report. This implementation represents about an 8 day (7.9) savings over the "typical" refueling outage of about 32 days (31.65). Coupled with the reduction of 57.5 days from the average BWR outage of 89.4 days an overall reduction of 73% is theoretically achievable.

Table 7-1
POTENTIAL BENEFIT ANALYSIS

Item	Description	Related Activity Time (Avg)	Estimated Time Savings	Projected Outage Time Savings: Critical Path	Projected Outage Time Savings: Noncritical Path	Outage Time Reduction	Man-Rem Savings
3.1	Maintenance procedures		80	30	50	30.0	1.60
3.2	Water clarity		30	30		30.0	
3.3	Unbolting drywell head	4.5	2.0	1.0	1.0	1.0	0.03
3.4	Removal of RPV head insulation	3.0	1.0		1.0		0.02
3.5	RPV head stud tensioner	21	2.0	2.0		2.0	0.20
3.6	Transfer slot RPV head studs	9	1.0	1.0		1.0	0.07
3.7	Cooldown of drywell		1.0	1.0		1.0	
3.8	Refueling platform	504	20	20		20.0	0.08
3.9	Verification of core loading	13.5	2.0	2.0		2.0	0.02
3.10	Steam line plug installation and removal	5.5	1.5	1.5		1.5	0.08
3.11	RPV head nut installation and removal	18.5	6.0	6.0		6.0	0.60
3.12	Control rod drive rebuilding	50.0	10		10.0		0.50
3.13	CRD retraction fixture	80.0	8.0		8.0		1.00
3.14	Local Power Range Monitor (LPRM)	16.5	5.0		5.0		3.05
3.15	Dropped articles in the RPV		30	30		30.0	2.50
3.16	Fuel loading (dunking) chamber hose routing		12	12		6.0	0.20
3.17	Tool and loose parts container		15	7.5	7.5	7.5	0.50
3.18	Planning and scheduling of containment valve repair		30		30		1.20
3.19	Documentation and followup on improvement suggestions		15	7.5	7.5	7.5	
3.20	General area cleaning and housekeeping		30	15	15	15	0.30

Table 7-1
POTENTIAL BENEFIT ANALYSIS (Continued)

Item	Description	Related Activity Time (Avg)	Estimated Time Savings	Projected Outage Time Savings		Outage Time Reduction	Man-Rem Savings
				Critical Path	Noncritical Path		
3.21	Safety relief valve flange bolting		5.0		5.0		0.60
4.1	Main steam isolation valve leak testing manifold	20	7.0		7.0		0.50
4.2	Rubber seated valves		10.0		10.0		
4.3	CRD servicing platform		4.0		4.0		3.50
4.4	Main steam safety relief valve transfer		7.0		7.0		0.14
4.5	Control rod blade guides		4.0	4.0		4.0	0.02
4.6	Head spray piping	17.4	10.0	5.0	5.0	5.0	0.05
4.7	Refueling platform	504	22.0	22.0		22.0	0.08
4.8	CRD removal and replacement	80	10.0		10.0		6.00
4.9	MSIV test fixtures		20.0		20.0		2.50
4.10	Functional friction test — CRD system	43	11.0	11.0		5.5	
4.11	Moisture separator removal and installation	21.5	1.5	1.5		1.5	0.11
4.12	CRD removal and replacement	80	5.0		5.0		0.50
4.13	Refueling platform fuel grapple		2.0	2.0		2.0	0.05
5.1	Redesign of reactor vessel stud removal tools	9	6	2.0	4.0	2.0	0.80
5.2	Moisture separator T-wrench improvements	21.5	8	8		8.0	1.20
5.3	Turbidity control		72	12	20.0	12.0	
5.4	Reactor pressure vessel stud cleaning device		4		4		0.10
5.5	Study of back-fitting of BWR-6 CRD handling equipment		60	20	40	20	3.00

Table 7-1
POTENTIAL BENEFIT ANALYSIS (Continued)

Item	Description	Related Activity Time (Avg)	Estimated Time Savings	Projected Outage Time Savings: Critical Path	Projected Outage Time Savings: Noncritical Path	Outage Time Reduction	Man-Rem Savings
5.6	Reactor pressure vessel nut removal tooling	18.5	16	8	8	8	0.16
5.7	Service line management		4	2	2	2	
5.8	Rapid engagement head spray line connection	17.4	12	12	4	8	0.12
5.9	Back-fit BWR-6 refueling platform	504	40	40		40	0.10
5.10	Reactor pressure vessel head tensioning/detensioning improvements		40				0.30
5.11	Loose parts prevention program		48	24	24	24	0.48
5.12	Develop minimum pass tensioning/ detensioning sequence		15	8		8	0.13
5.13	Reactor pressure vessel stud thread lubricant application		2.5		2.5		0.03
5.14	Loose parts retrieval program		45	20		20	0.45
5.15	Reactor cavity elevator		15	8	7	8	0.50
5.16	Communications		24	12	12	12	0.40
5.17	Decontamination equipment		8	4	4	4	0.50
5.18	Multiple LPRM handling strongback	16.5	7	4	3	4	0.10
5.19	Reactor pressure vessel recirculation outlet nozzle debris screens		4	4		4	
5.20	Reactor pressure vessel recirculation outlet nozzle plugs		4	4		4	
5.21	Main steam line plug holder for MSIV test	20	4		4		0.50
5.22	Optical positioning of refueling platform grapple		24	24		24	0.10
5.23	Improved platform drives		1	1		1	0.03
	TOTAL, man-Rem						35.0

Table 7-2
TIME SAVINGS

Outage Activities (Figure 7-1)	Benefit Items (Table 7-1)	Projected Time Savings: Critical	Projected Time Savings: Noncritical	Explanation
1. Remove shield blocks (reactor well, equip pool, fuel pool)	None			No significant procedure or equipment changes noted
2. Unbolt and remove drywell head	3.3 5.7	1.0 0.5 1.5		By increasing tool quantities and better service (air, electric, etc.) improvement will be seen
3. Remove RPV head and accessories. (Head spray piping, detensioning and removal of nuts and washers)	3.5 3.11 4.6 5.1 5.6 5.8 5.12	1.0 3.0 2.5 2.0 4.0 4.0 4.0 20.5		Head spray line improvement. Reactor vessel studs and nut removal improvements
4. Remove dryer, separator, slot studs, and install MSL plugs	3.6 3.10 4.11 5.2	1.0 0.75 0.75 3.0 5.50		Moisture separator tooling improvements transfer slot studs.
5. Flood up cavity and clean up H_2O	3.2 5.3	15.0 6.0 21.0		Water clarity (turbidity/control)
6. Unload core — inspection	3.8 4.7 4.13 5.22	10.0 11.0 1.0 12.0 34.0		Improvements to refueling platform, bridge and grapple
7. Install shield blocks	None			No significant changes
8. Drain and decontaminate reactor cavity well	5.15 5.17 5.7 5.16	4.0 4.0 0.5 4.0 12.5		Decontamination improvements
9. RPV ISI (Internal and other in-vessel inspection)	5.15 5.16	4.0 4.0 8.0		Improved communications and reactor cavity elevator

Table 7-2
TIME SAVINGS (Continued)

Outage Activities (Figure 7-1)	Benefit Items (Table 7-1)	Projected Time Savings: Critical	Projected Time Savings: Noncritical	Explanation
10. LPRM replacement	3.14 5.18	 4.0 4.0	5.0 3.0	Multiple LPRM strongback
11. Remove surveillance samples, inspect sources, flood-up	5.16	4.0		Communications between refuel floor and vessel flange
12. Reload core	3.8 4.7 4.13 5.22 5.23 3.16 4.5	10.0 11.0 1.0 12.0 1.0 6.0 4.0 45.0		Refueling platform improvements
13. Verify core loading	3.9	2.0		Backup cameras
14. CRD friction testing	4.10	5.5		Communication improvement
15. Install separator and slot studs, remove MSL plugs, install dryer	3.10 4.11 5.2	0.75 0.75 5.0 6.50		Tooling improvements
16. Install RPV head and accessories	3.11 3.5 4.6 5.6 5.8 5.12	3.0 1.0 2.5 4.0 4.0 4.0 18.5		Head spray line improvements stud tensioning improvements
17. RPV hydro	None			No significant time savings noted
18. Install and bolt drywell head	3.3 5.7	0.5 0.5 1.0		Tooling and service management improvements
19. ILRT	None			None
20. Install shield blocks	None			None

Table 7-2
TIME SAVINGS (Continued)

Outage Activities (Figure 7-1)	Benefit Items (Table 7-1)	Projected Time Savings		Explanation
		Critical	Noncritical	
21. Startup and testing	None			None
22. Drywell entry	3.7		1.0	Cooldown Improvement
23. MSIV leak testing	4.1 5.21		77.0 4.0	Leak test manifold and MSL plugs
24. MSIV repair and retest	3.1 3.20 4.1 4.9 5.21 3.17		20.0 5.0 7.0 20.0 4.0 4.0	Test fixtures, procedures, housekeeping
25. Containment valve leak test	3.1 3.18 4.2 3.20		20.0 30.0 10.0 5.0	Procedures, planning, cleaning valve seat changes
26. Torus inspection				None
27. Inspect-repair snubbers				
28. In-service inspection drywell				
29. CRD removal and replacement	3.1 3.12 3.13 4.3 4.8 4.12		5.0 2.0 4.0 4.0 5.0 5.0 5.0	Improved tooling and handling equipment
30. TIP servicing				No significant improvements observed

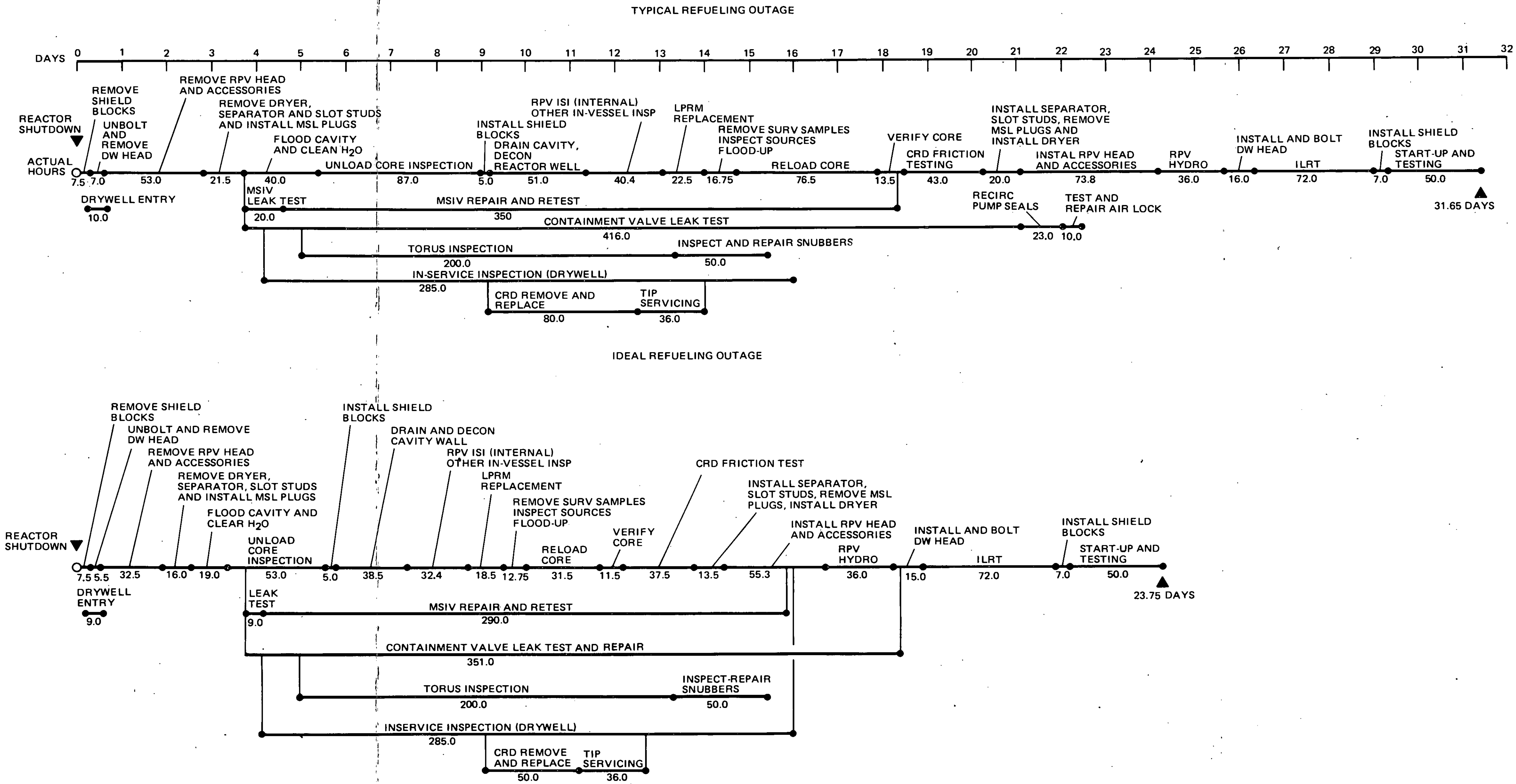

Figure 7-1. Typical Refueling Outage

8. CONCLUSIONS — TOTAL BENEFITS

The results of the Phase 1 study show that a significant improvement in plant availability is attainable. By incorporating the recommendations and taking credit for the time savings, an "ideal" refueling outage length of 24 days for the NSSS could be realized with an expected average annual outage time reduction of 8 days from the "typical" refueling outage length for each plant, implementing the recommendations provided by this study. There is a savings in manpower of approximately 1000 man-hours for routine refueling activities only; there is also a savings of about 35 man-Rem in personnel radiation exposure, which represents a 25% reduction for routine refueling activities and a 10% reduction for the entire refueling outage. There is a savings in replacement energy cost of about $1.5 million per 1100 MWe unit. If the replacement power were from an oil-fired unit, the oil savings would be approximately 250,000 barrels.

The longer-range savings expected from the implementation of the generic recommendations will benefit both currently operating plants and plants presently in the design and construction stages. Based on the generic recommendations, it is estimated that the average annual outage will be decreased by as much as 8 days for these plants. It is estimated that by 1985, a total annual savings from nuclear power plants of GE design will be approximately 600 days. The savings in replacement energy cost is estimated to be $125 million. Replacement energy fuel savings are estimated to be equivalent to 20 billion barrels of oil per year. These savings are based on an assumed nuclear operating capacity of 75,000 MWe supplied by the same 85 nuclear power plants.

The program to evaluate and improve nuclear power plant availability is a vital part of managing the nation's energy resources. Through the combined efforts of Georgia Power, Power Authority of the State of New York (PASNY), Commonwealth Edison, TVA, GE and DOE, a significant reduction in outage time can be realized. The goal of the shortest outage coupled with the completion of the maximum amount of work with reduced man-Rem exposure is significant in improving nuclear power plant availability and reducing the dependence of the utility industry on expendable fossil fuels.

Appendix A

PHOTOGRAPHS OF PHASE I REFUELING ACTIVITIES, GENERAL AREA VIEWS, AND BALANCE-OF-PLANT ACTIVITIES

LIST OF ILLUSTRATIONS

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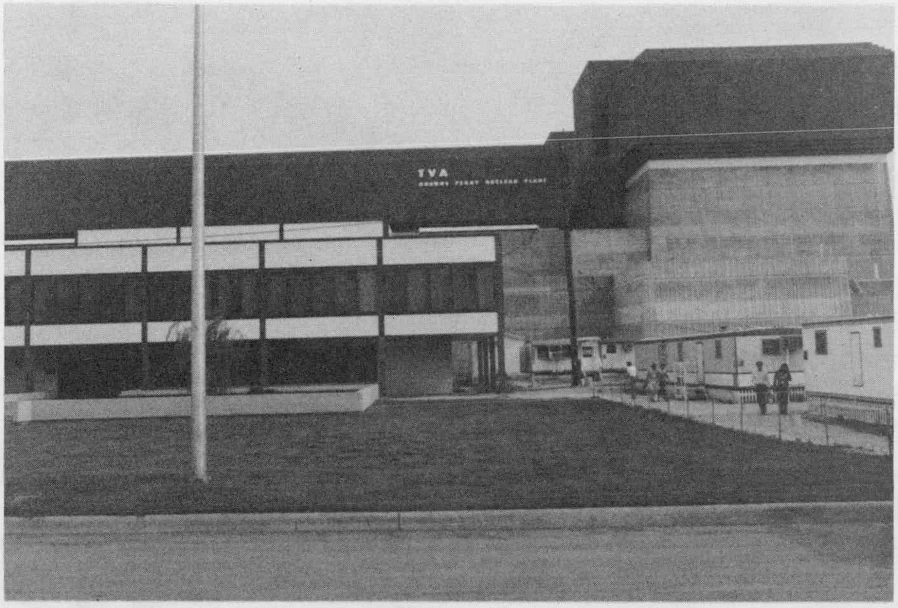


Figure 1. Tennessee Valley Authority's (TVA) Browns Ferry Nuclear Power Station, Decator, Alabama (Front View with Administration Building and Outage Support Trailer Offices

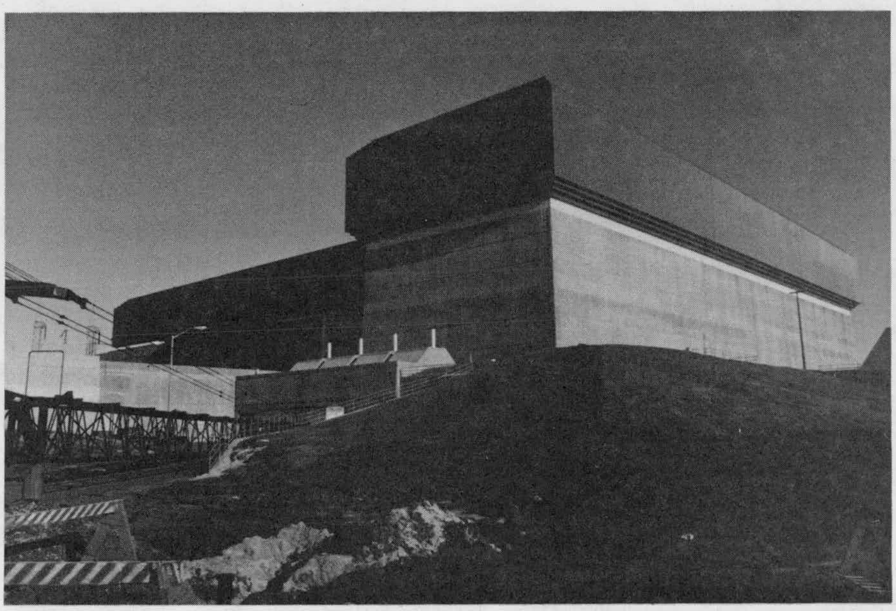


Figure 2. Browns Ferry Nuclear Power Station (River View)

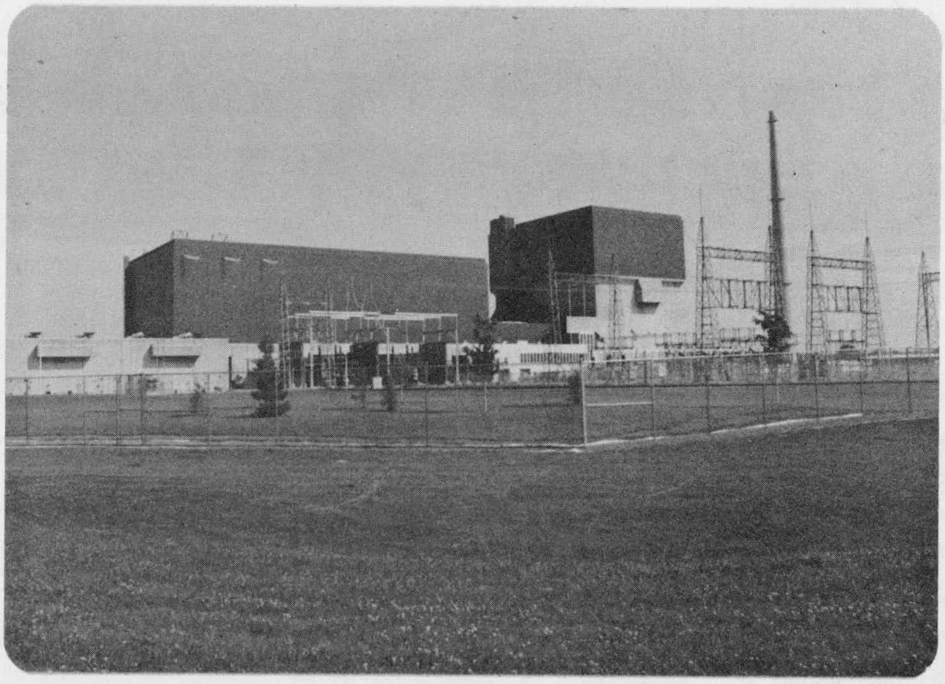


Figure 3. Public Service of New York (PASNY) Fitzpatrick Nuclear Power Station, Oswego, N.Y. (West View)

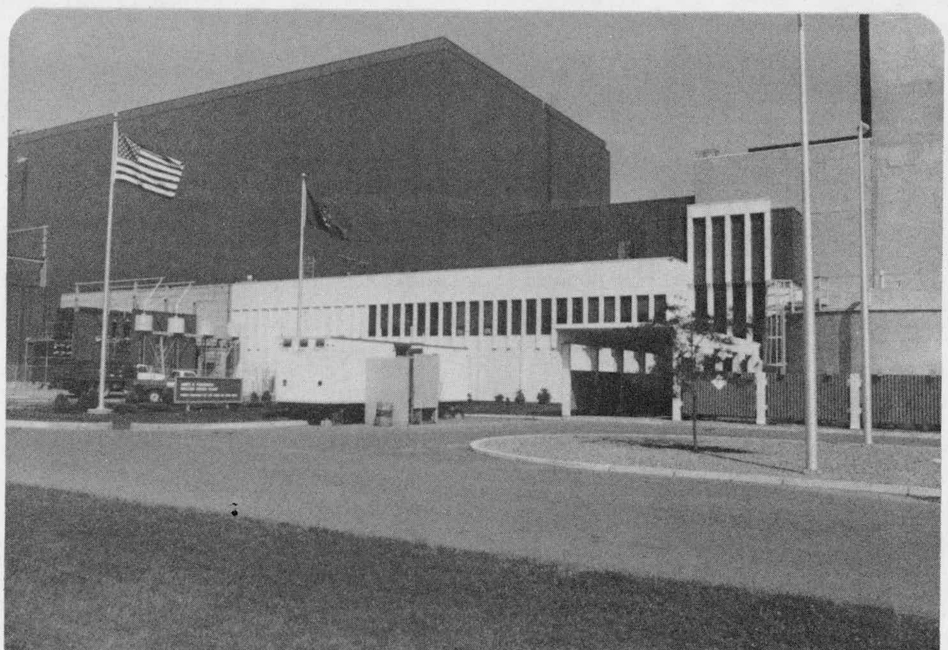


Figure 4. Fitzpatrick NPS Administration Building (Fitzpatrick)

Figure 5. Niagara Mohawks Nine Mile Point 1 with Nine Mile Point 2 Construction Site and Fitzpatrick's Power Switch Yard in the Foreground

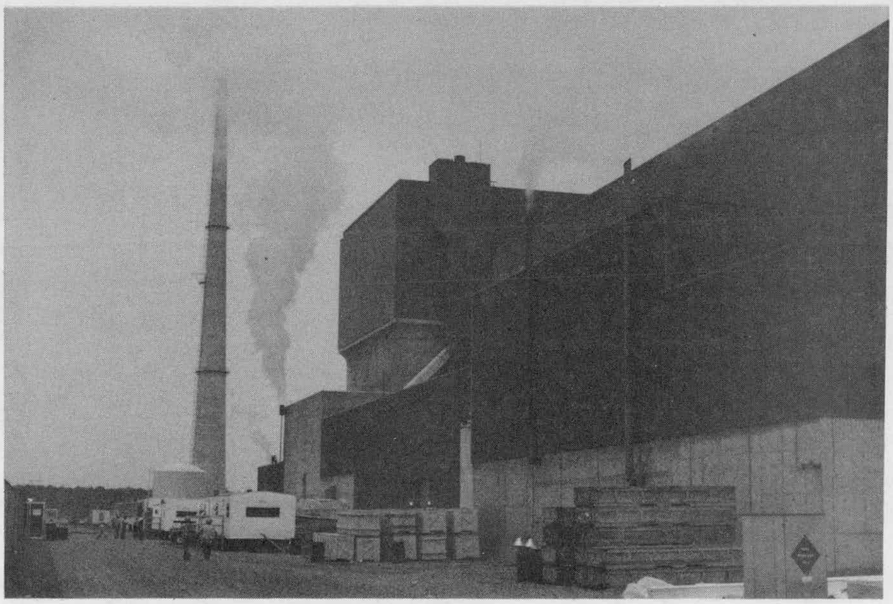


Figure 6. Fitzpatrick NPS East Side with Outage Support Trailer Offices ERDA Outage Monitoring Office Located in the First Trailer

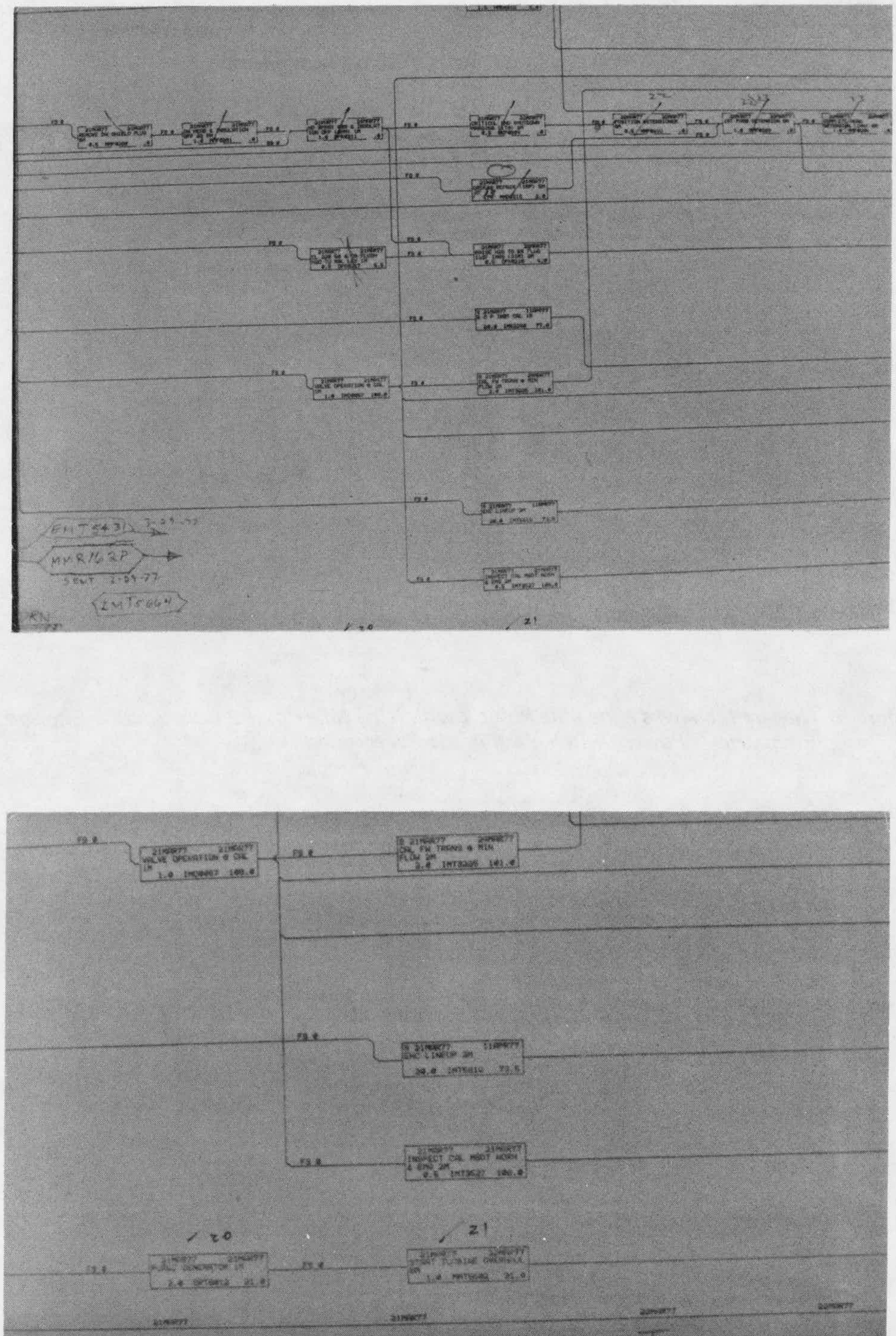


Figure 7. Outage Critical Path Flow Chart (Quad Cities)

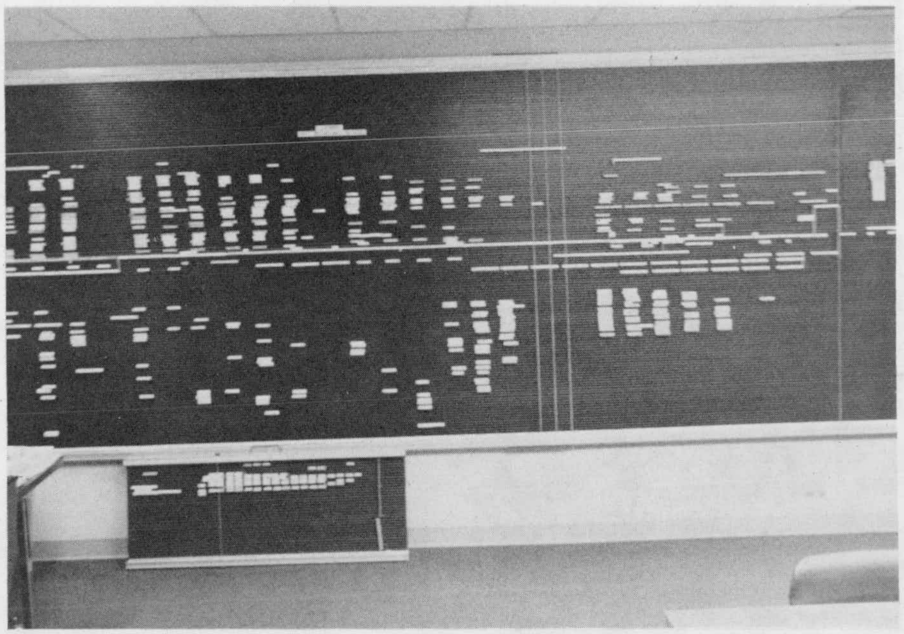


Figure 8. Critical Path Flow Chart in Outage Control Office (Fitzpatrick)

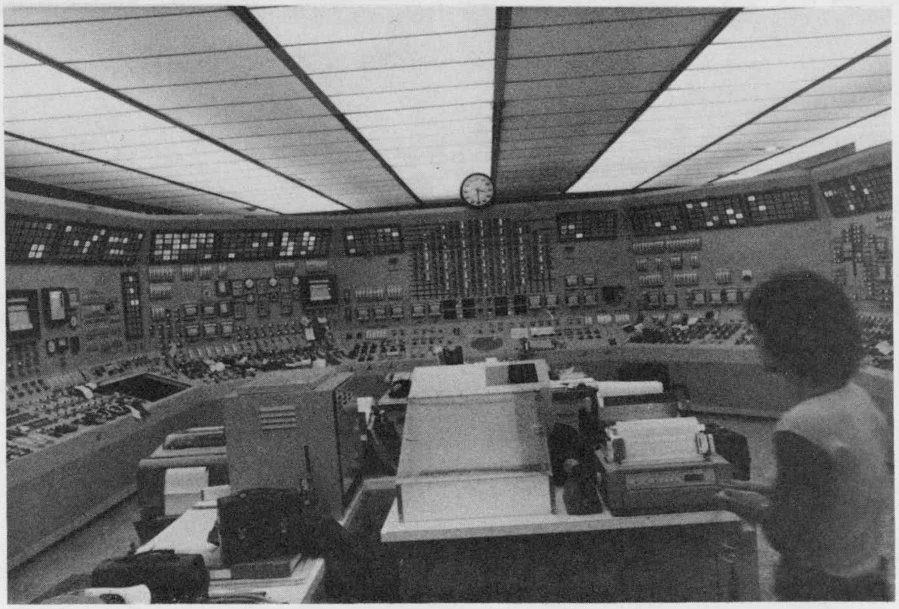


Figure 9. Station Control Room (Browns Ferry)

Figure 10. Control Room (Fitzpatrick)

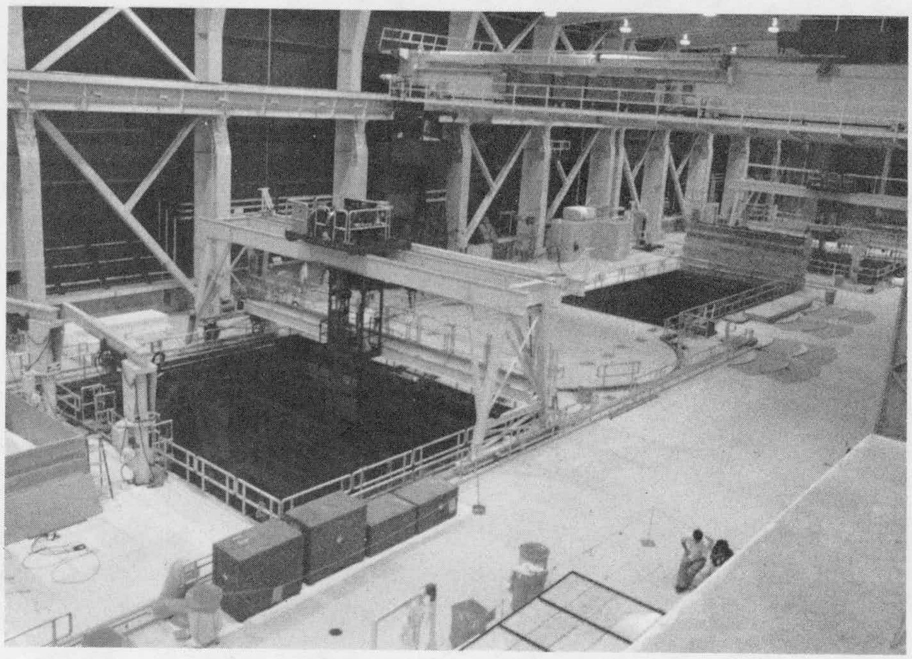


Figure 11. Refueling Floor During Reactor Power Operation (Browns Ferry)

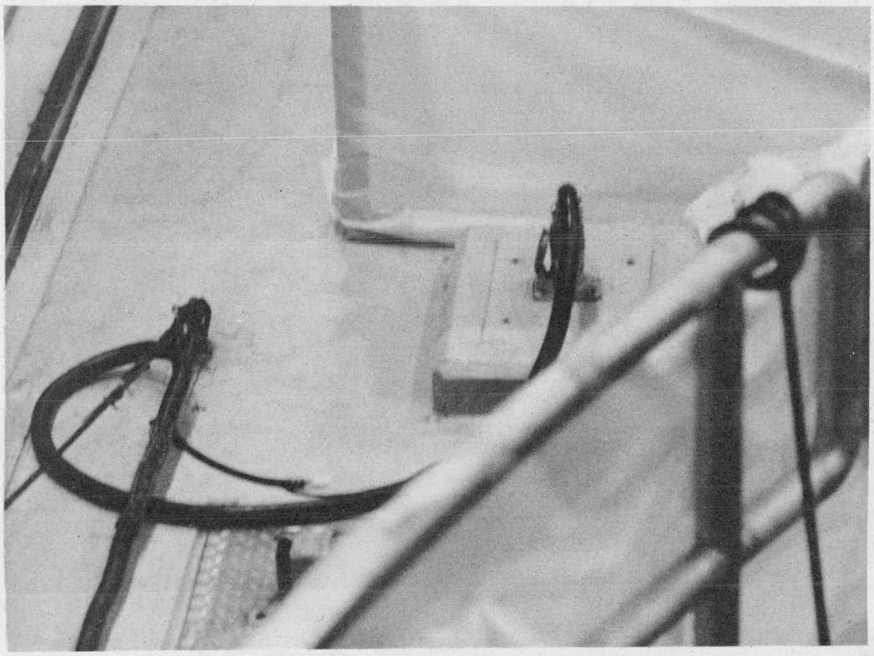


Figure 14. Refueling Platform Power Cable (See Figure 13) and Floor Connection Cable and Connector Flexing Cause Bridge Power Interruptions and Fueling Delays (Browns Ferry)

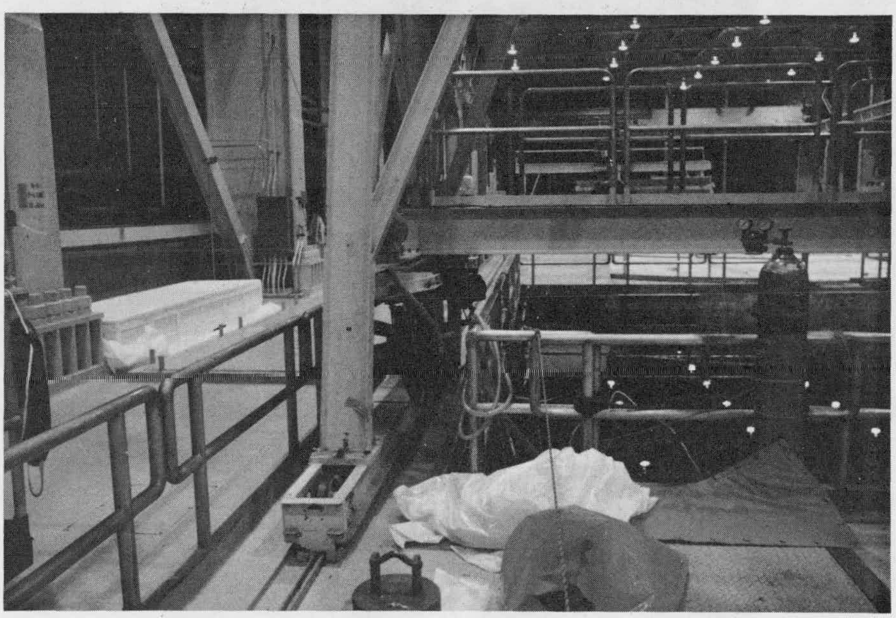


Figure 15. Refueling Bridge Truck, Unflanged Wheel and Track—Keeping the Bridge on the Track is Sometimes a Problem, Especially if Guide Rollers and Track are Misaligned (Browns Ferry)

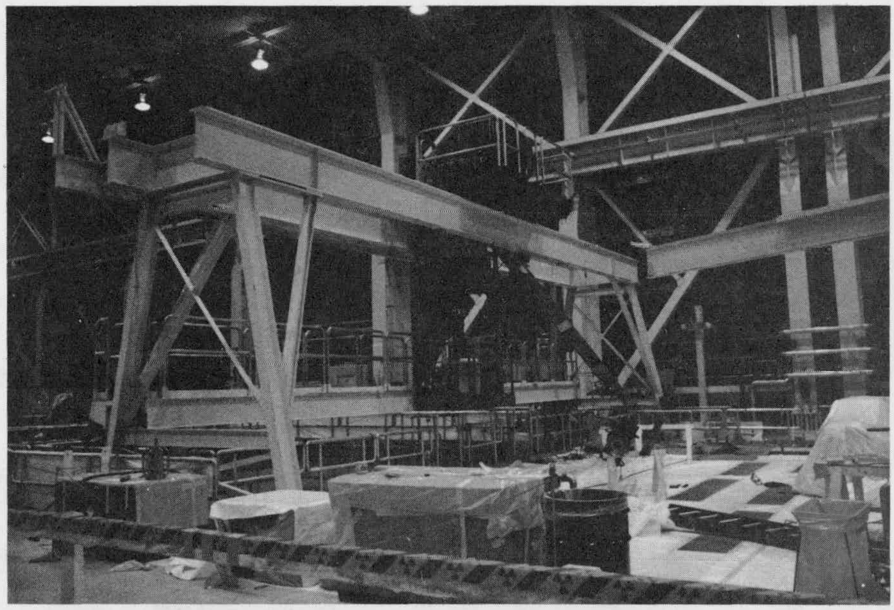


Figure 12. Refueling Platform (Bridge) and Fuel Grapple (Browns Ferry)

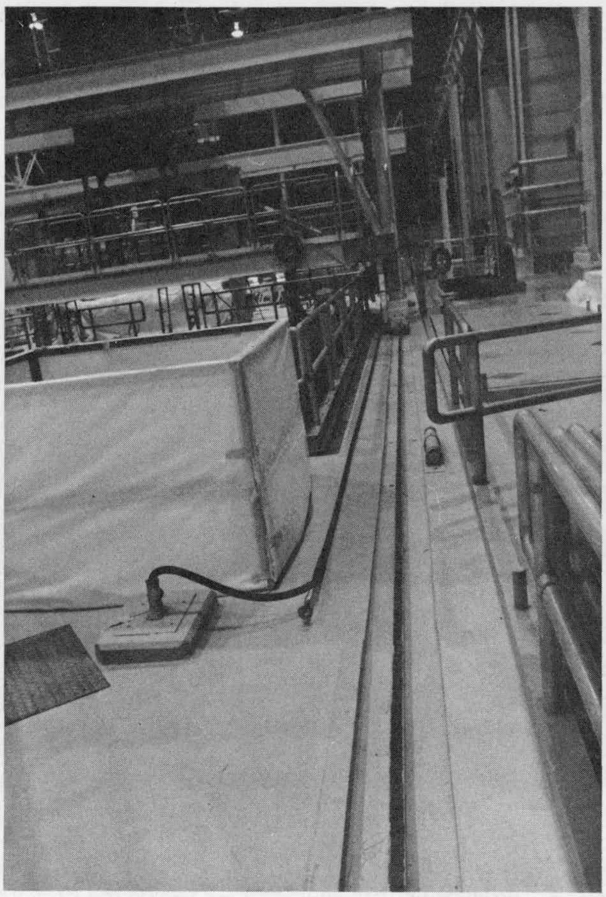


Figure 13. Refueling Platform Power Cable and Floor Connection (See Figure 14) Cable and Connector Flexing Cause Bridge Power Interruptions and Fueling Delays (Browns Ferry)

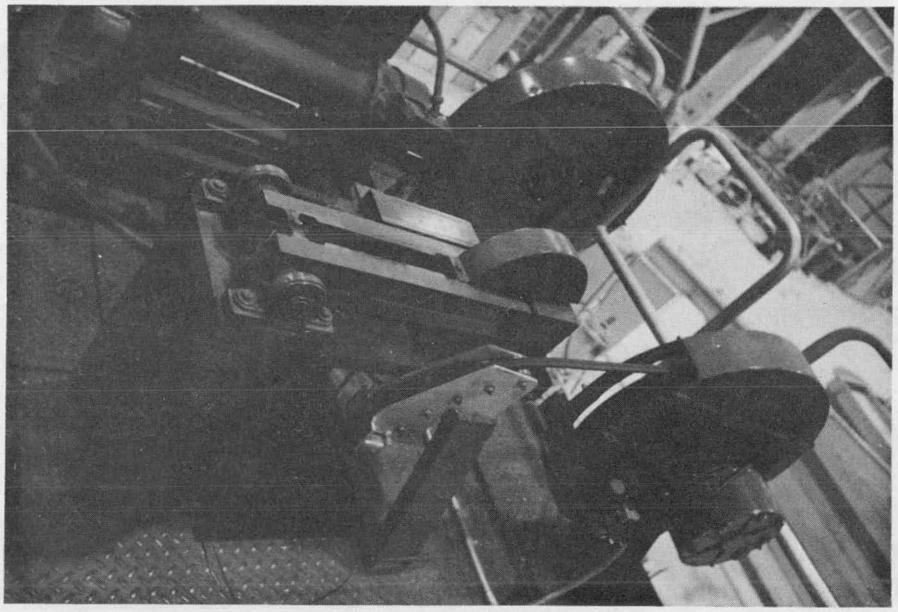


Figure 18. Bridge Trolley Main Hoist Sheave and Load Gage Assembly (Cover Removed for Servicing) and Grapple Compressed Air Hose and Electrical Cable Supply Reels (Browns Ferry)

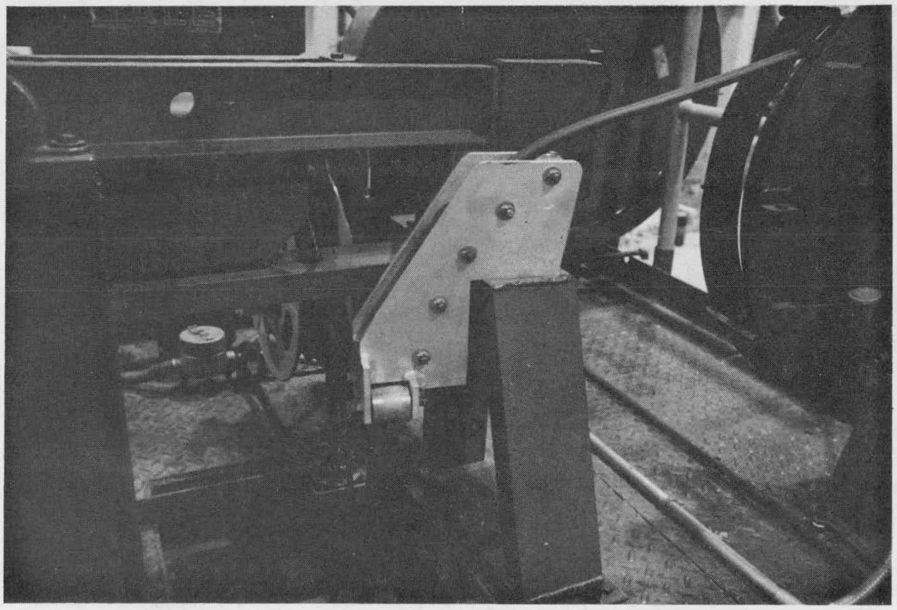


Figure 19. Special Air Hose Support to Reduce Wear and Binding (Browns Ferry)

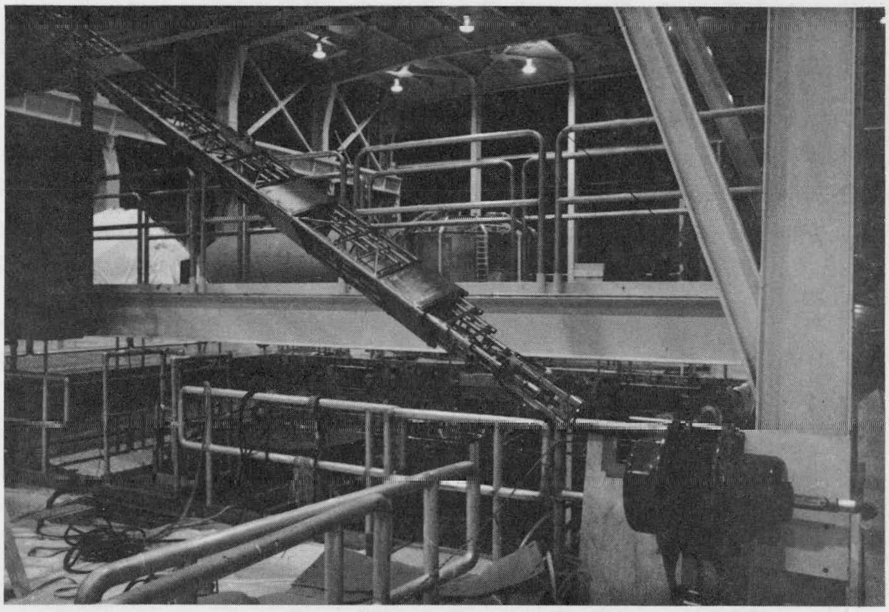


Figure 16. Fueling Grapple and Tower Frame (Fully Retracted and Lifted)—The Failure of Pneumatic and Electrical Components Delay Fueling. (Browns Ferry)

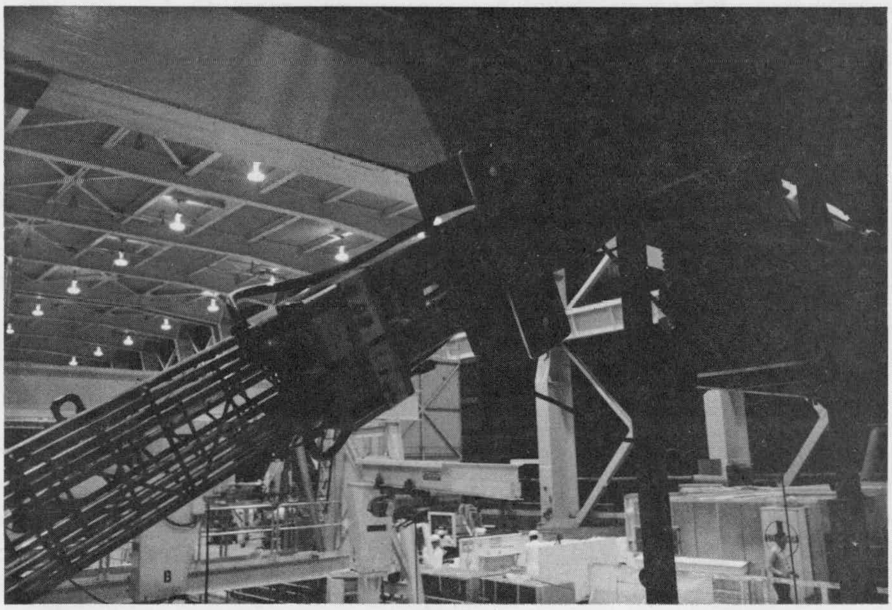


Figure 17. Grapple Operator Controls and Instruments — Incorrect or the Lack of Proper Control and Indication Cause Errors and Delays (Browns Ferry)

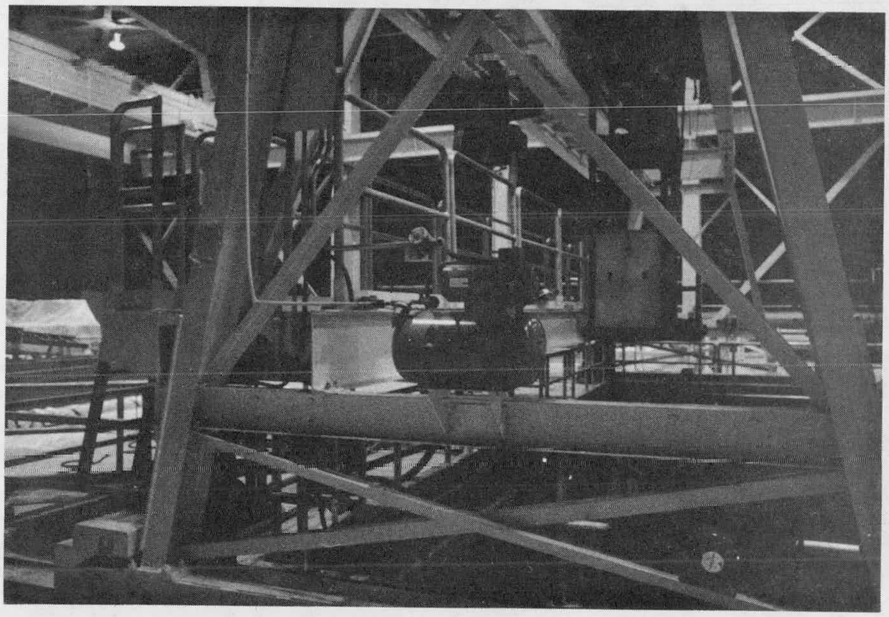


Figure 20. Refueling Bridge Main Compressed Air Supply Tank and Compressor (Browns Ferry)

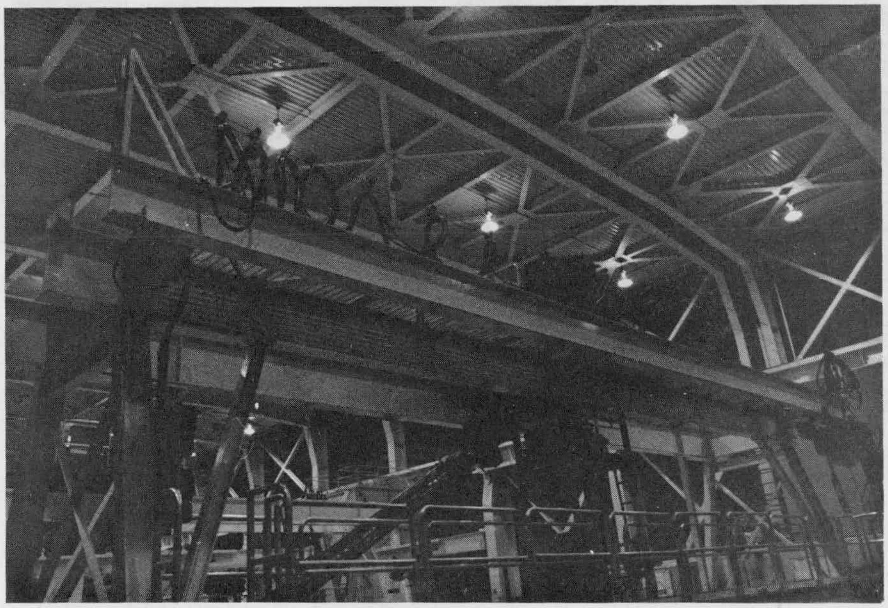


Figure 21. Bridge Upper Structure and Festooned Cables—Frequent Flexing of Special Heavy Shielded Power Cables to Trolley and Monorail Hoists Cause Excessive Wear and Failure at Tag Line Supports (Browns Ferry)

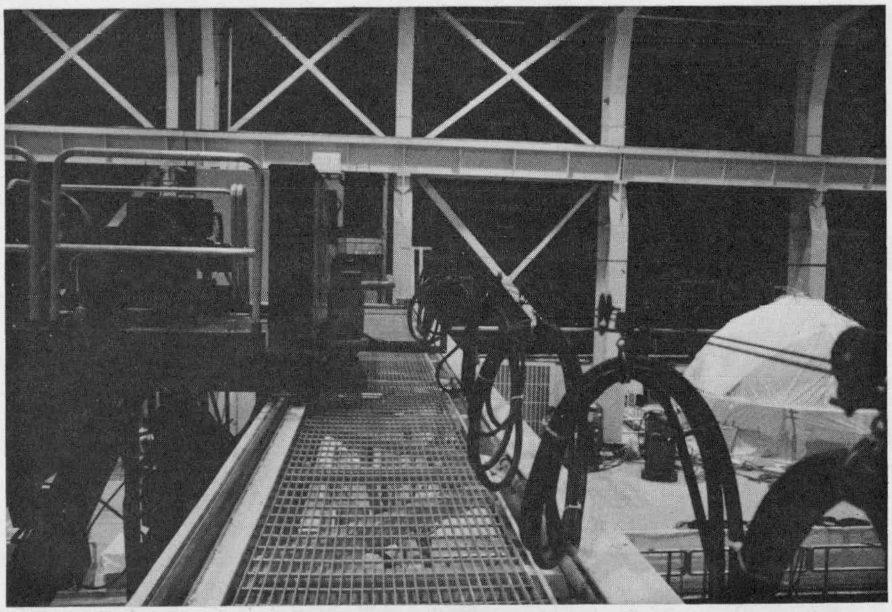


Figure 22. Festoon Cable and Tag Line Supports (Browns Ferry—3)

Figure 23. Bridge Trolley Drive Motor and Upper Cab Support Equipment Main Hoist (Browns Ferry)

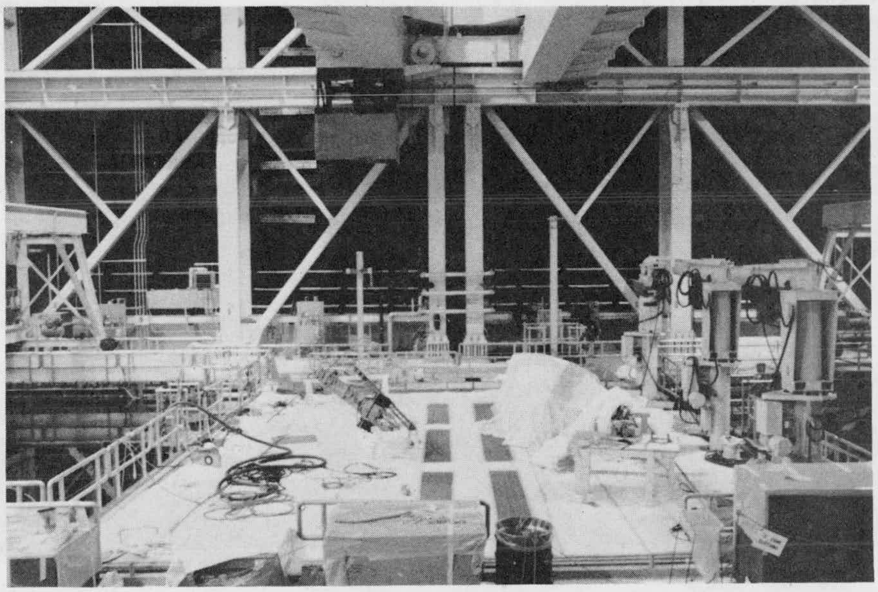


Figure 24. Refueling Floor Equipment Lay-Down Area and Fuel Pool Jib Cranes and Cab Controlled Overhead Crane (Browns Ferry)

Figure 25. Refueling Floor Overhead Crane with Twenty-Ton Hoist and Dual Hook (Browns Ferry)

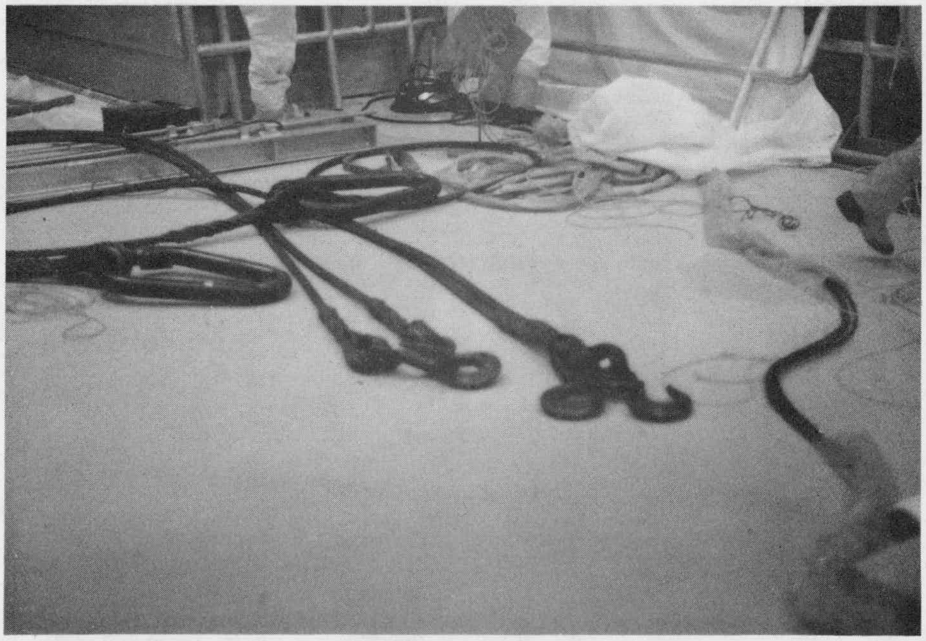


Figure 26. Crane Hook-Two Leg Bridle Slings (Browns Ferry)

Figure 27. Rigging Inspection and Mounting for Lift - Note Center Hook Hole Used for Lifting Bail (Browns Ferry)

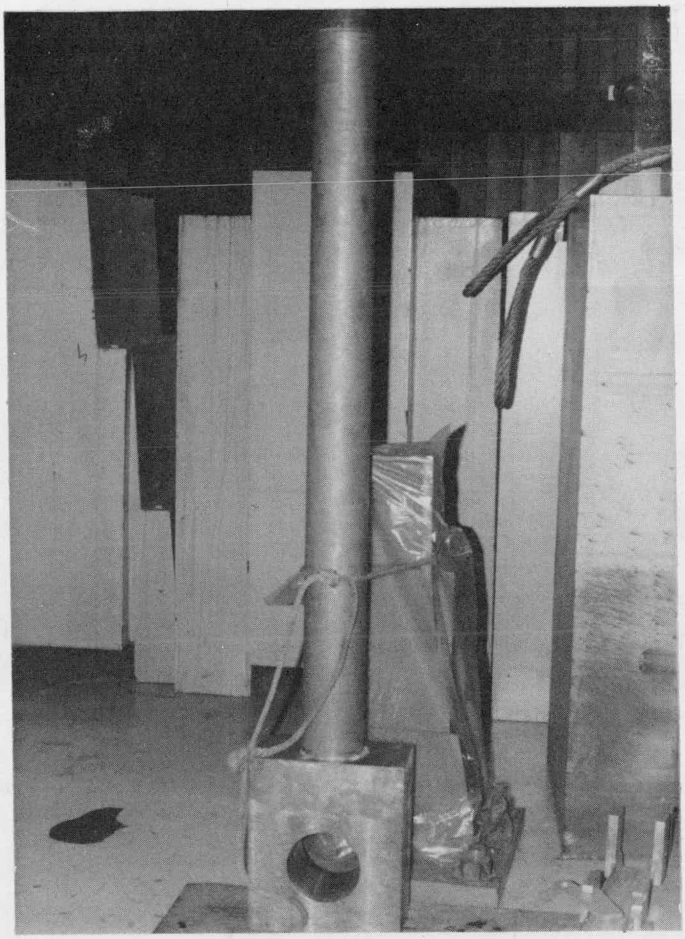


Figure 28. Crane Hook Centering Adaptor Used Where Center Hook Hole is Not Provided (Quad Cities)

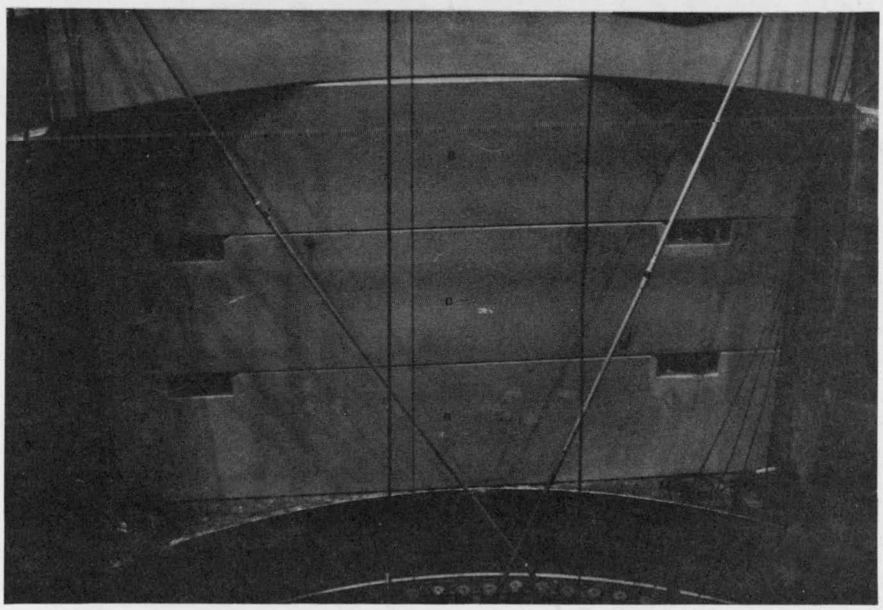


Figure 29. Equipment Pool Shield Blocks - In Position from RPV Cavity Side (Browns Ferry)

Figure 30. Rigging to Second Layer Center Block (Hatch)

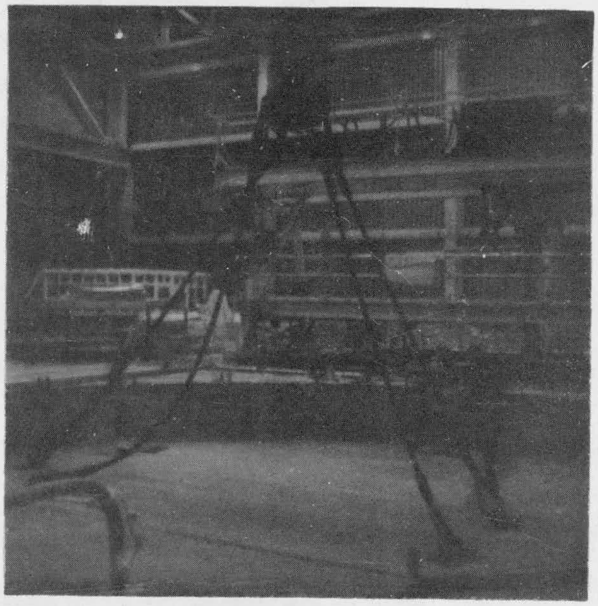


Figure 31. Second Layer Center Long Sling to Left (Hatch)

Figure 32. Center - Stuck on Far Corner Using Pry Bar to Loosen (Hatch)

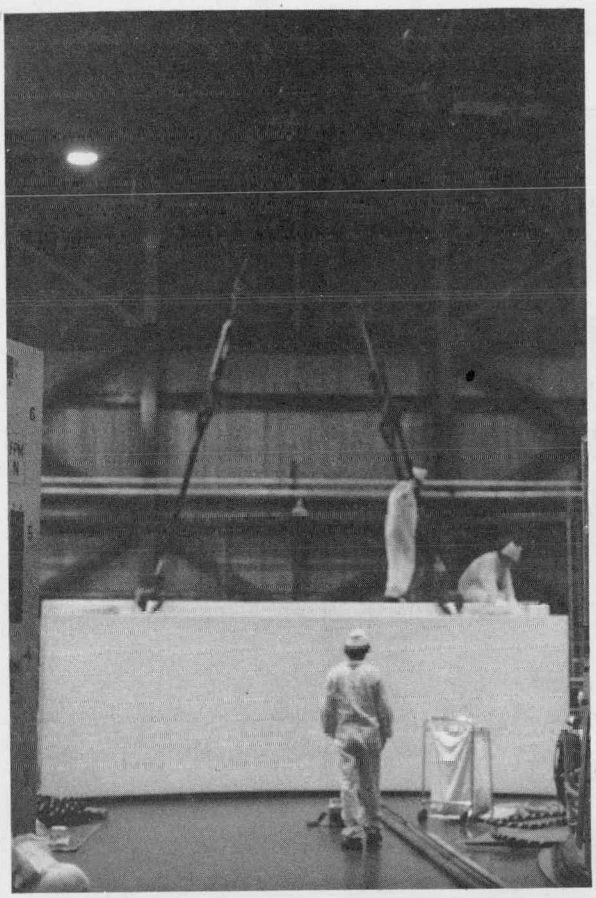


Figure 33. Pre-test and Leveling of Shield Block Rigging Saved Critical Path Time (Fitzpatrick)

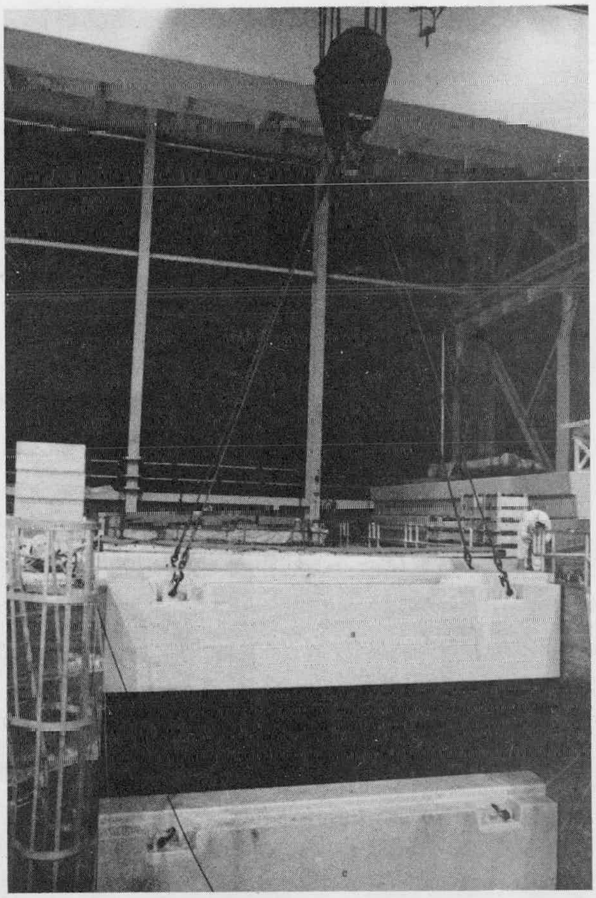


Figure 34. Removing Third Equipment Pool Block (Browns Ferry)

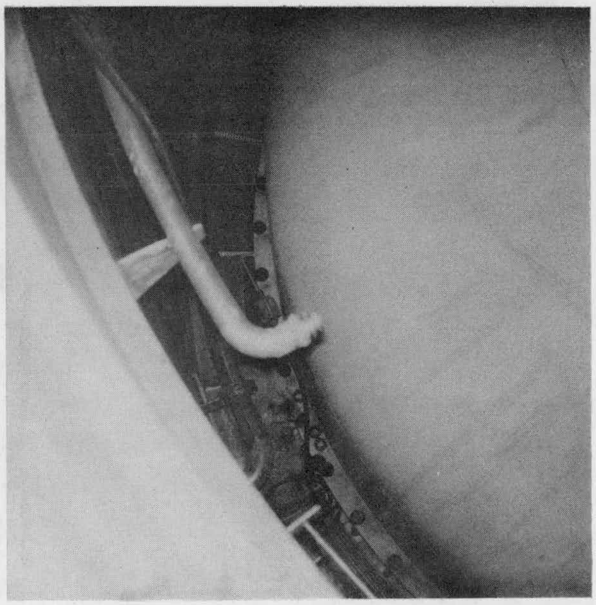


Figure 35. Unbolting DW Head (Hatch)

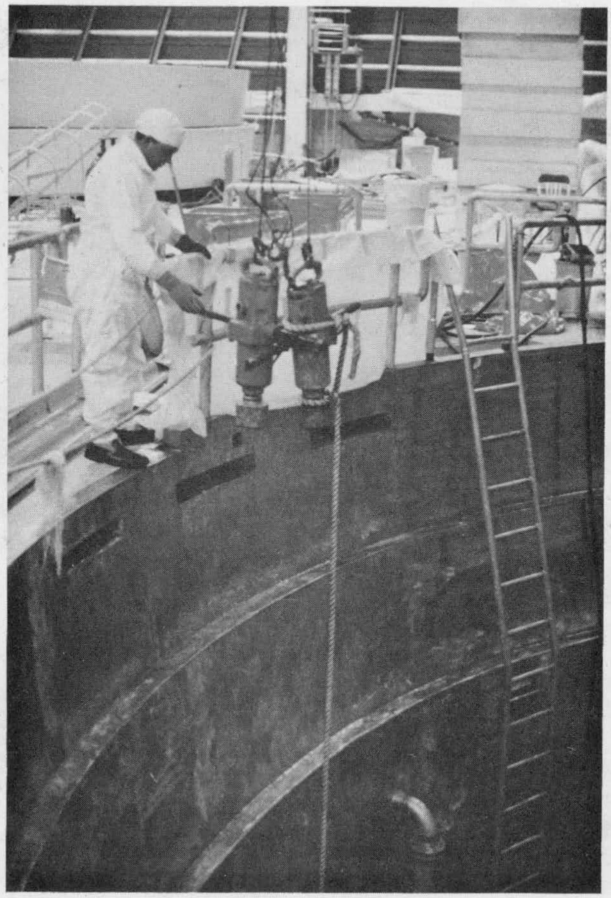


Figure 36. Lowering Drywell Head Bolt Removal Tools into Reactor Cavity (Browns Ferry)

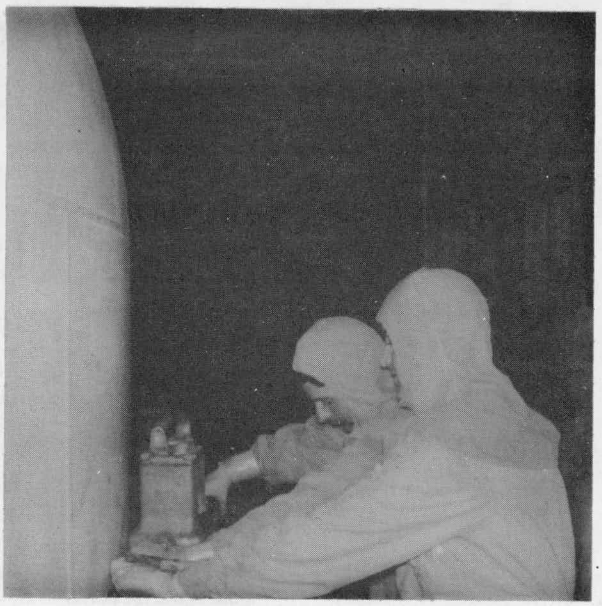


Figure 37. Untorquing DW Bolt (Hatch)

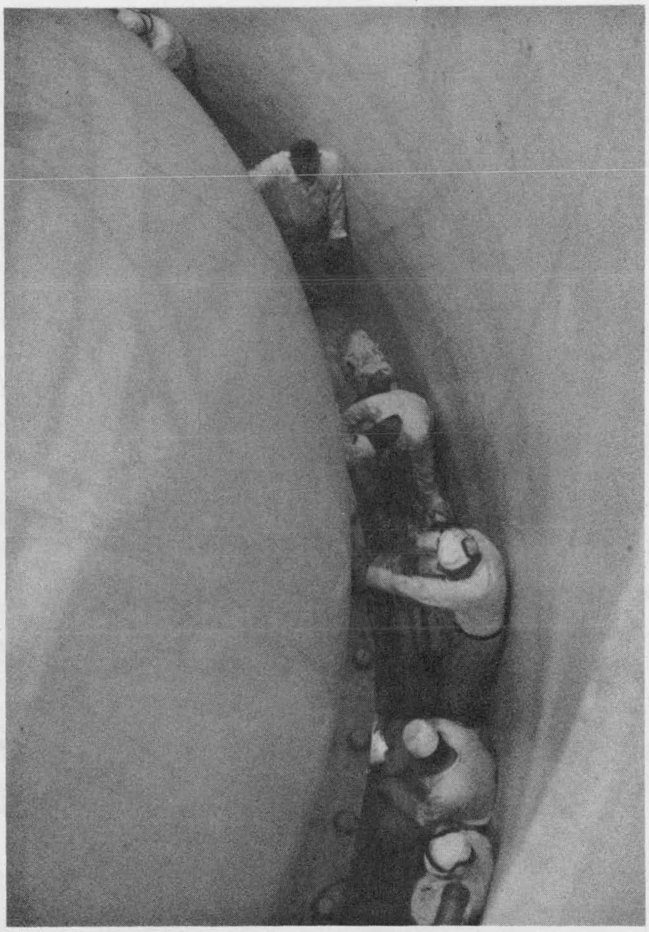


Figure 38. Drywell Head Bolt Removal Crew (Fitzpatrick)

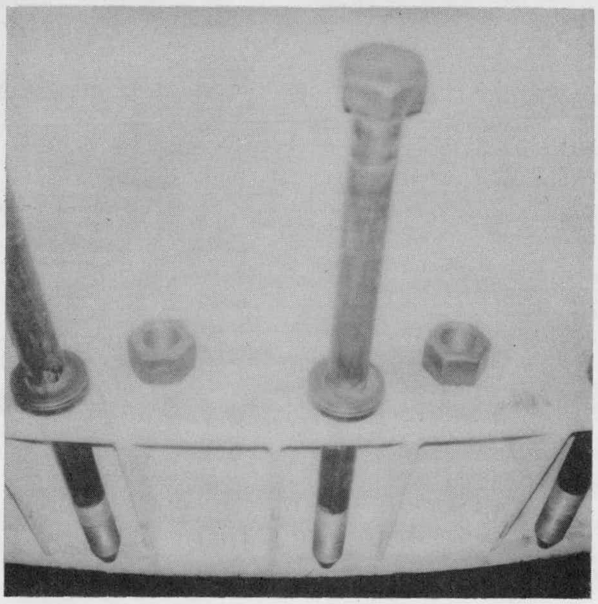


Figure 39. Drywell Head Bolts Loose (Hatch)

Figure 40. Corroded and Broken Drywell Head Bolts (Quad Cities)

Figure 41. Drywell Head Bolts Stacked on Refueling Floor (Fitzpatrick)

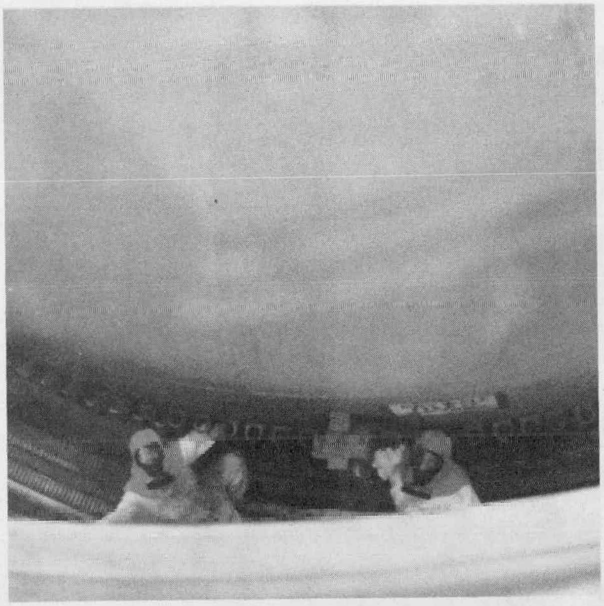


Figure 42. Drywell Head Bolt Removal Crew Find Masks Hinder Communications (Browns Ferry)

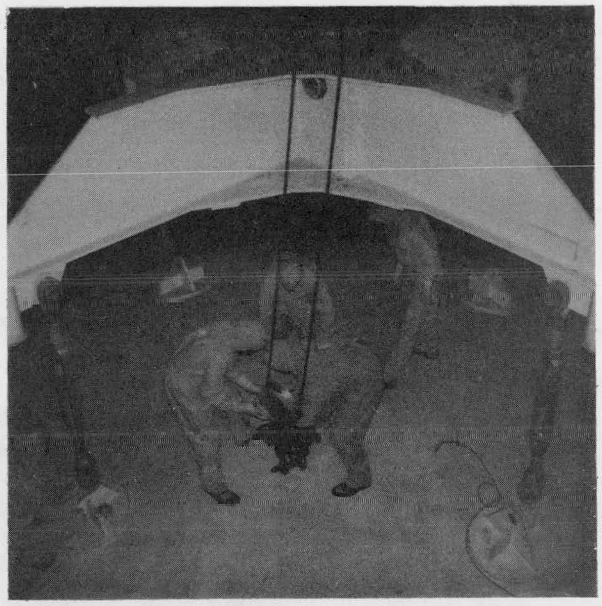


Figure 43. Rigging Drywell Head to Remove

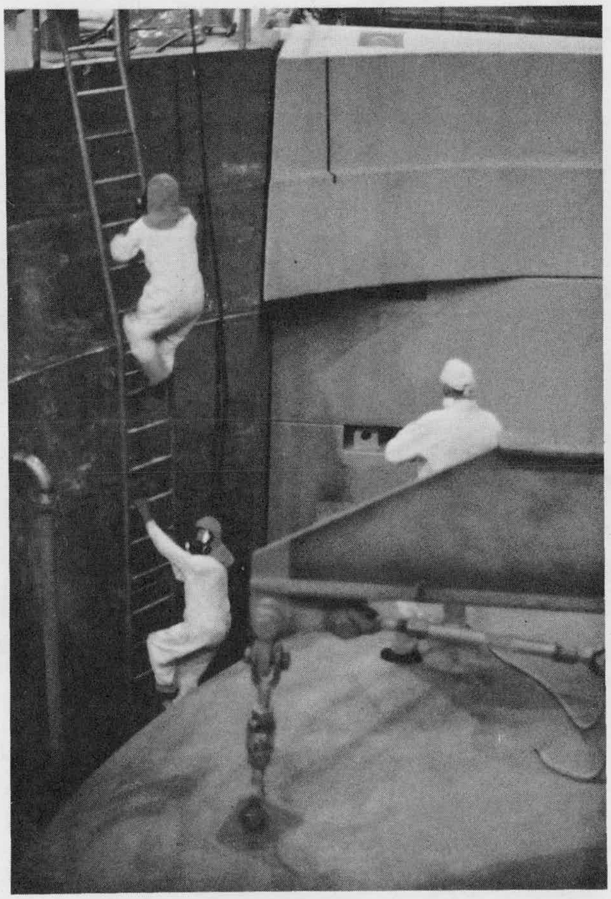


Figure 44. Drywell Head Removal Crew Exiting Reactor Cavity (Browns Ferry)

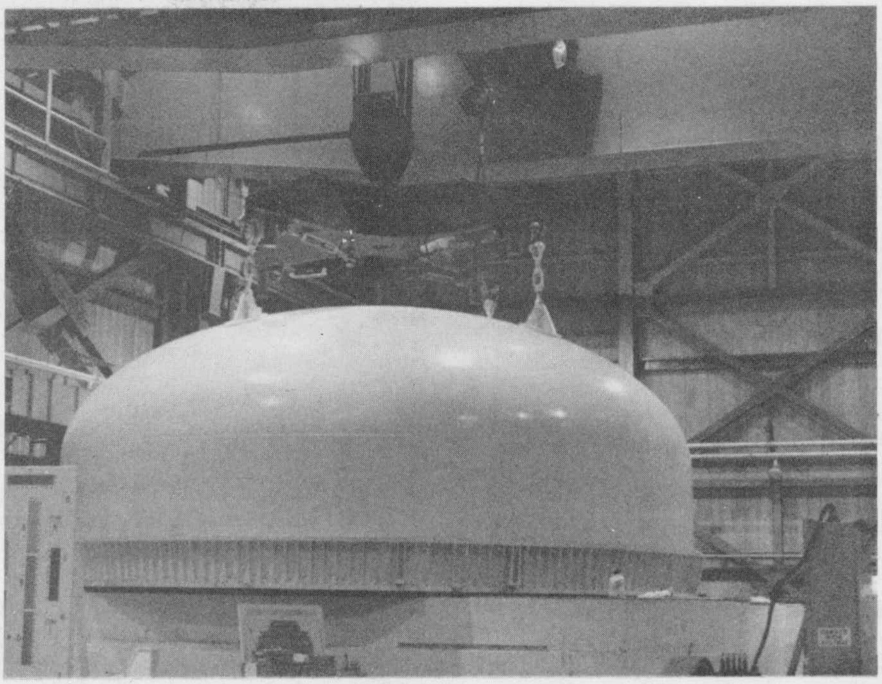


Figure 45. Setting Drywell Head on Reactor Cavity Block on Refueling Floor (Browns Ferry)

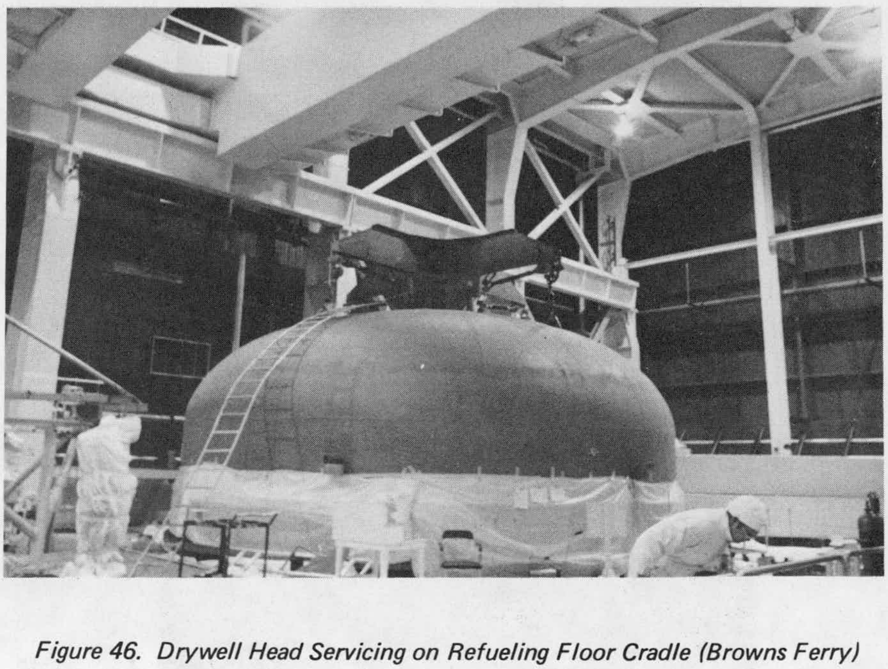


Figure 46. Drywell Head Servicing on Refueling Floor Cradle (Browns Ferry)

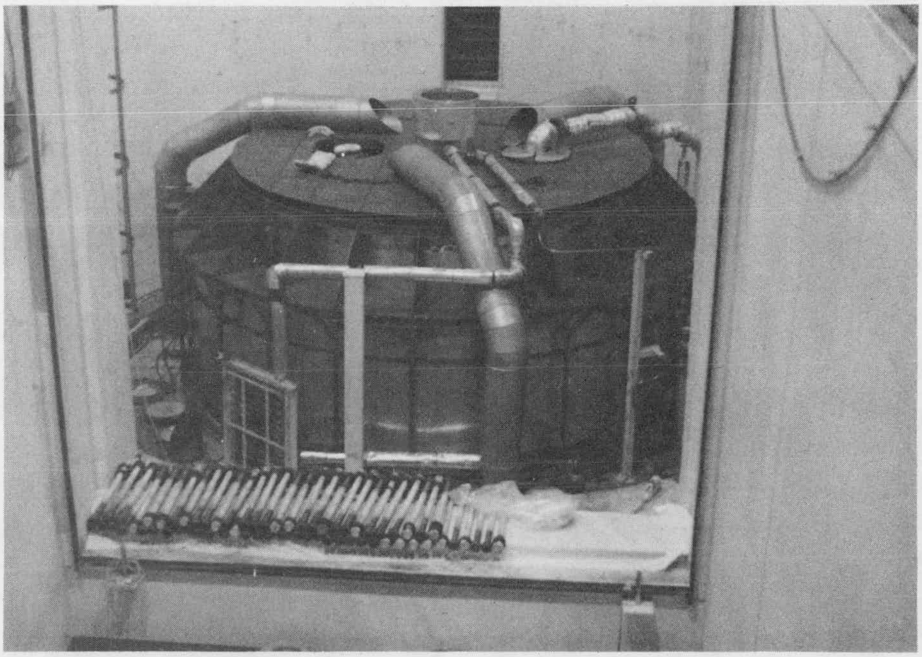


Figure 47. Reactor Head Mirror Insulation, Reactor Head Vent and Liquid Level Sensing Piping and Cooling Ducts (Browns Ferry)

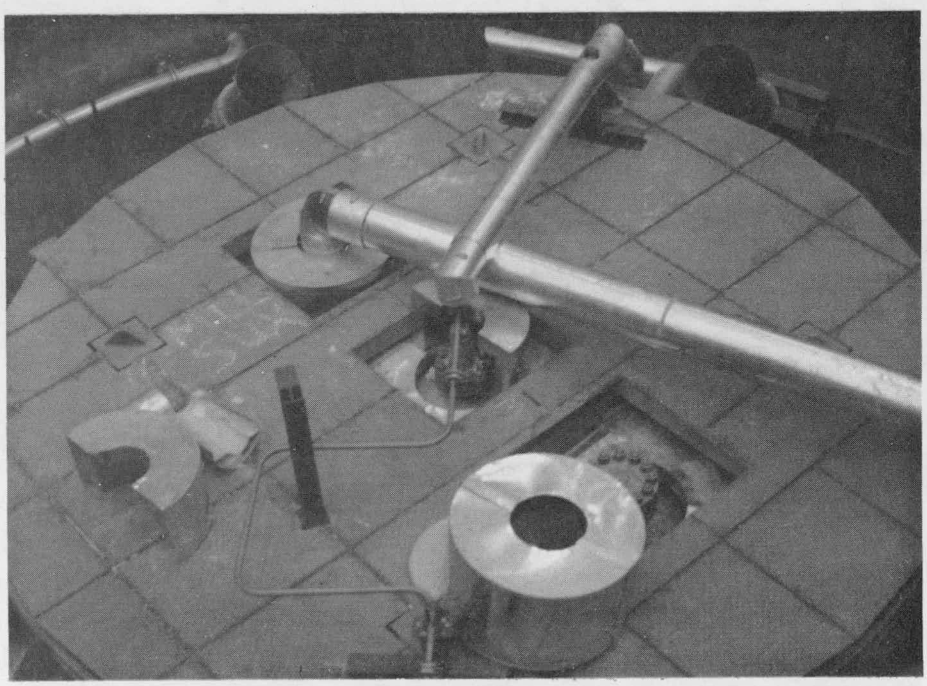


Figure 48. Removing Mirror Insulation from Reactor Head Nozzles

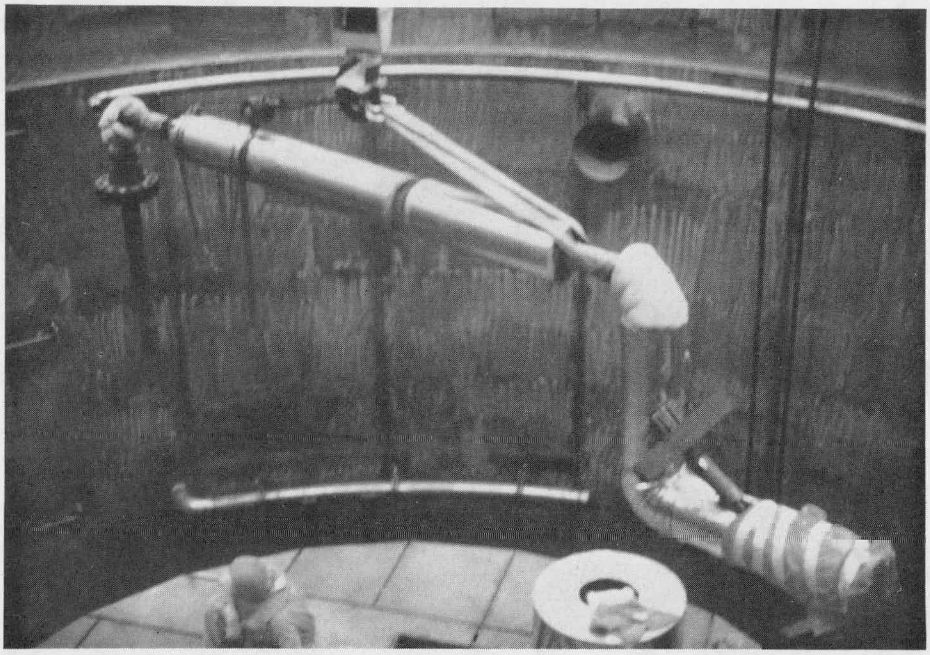


Figure 49. Removing Reactor Head Vent Piping (Fitzpatrick)

Figure 50. Rigging for Removal of Mirror Insulation (Browns Ferry)

Figure 51. Lifting Mirror Insulation from Cavity - Crane Rigging too Long to Clear Refueling Floor; Had to Reset Insulation and Re-rig. Need Lifting Strong Back (Hatch)

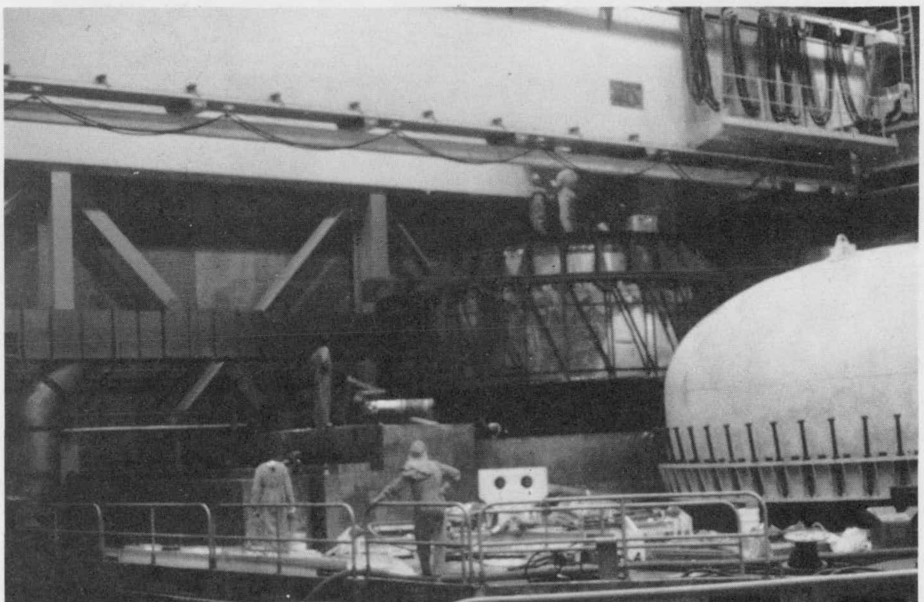


Figure 52. Setting Mirror Insulation on Reactor Cavity Blocks

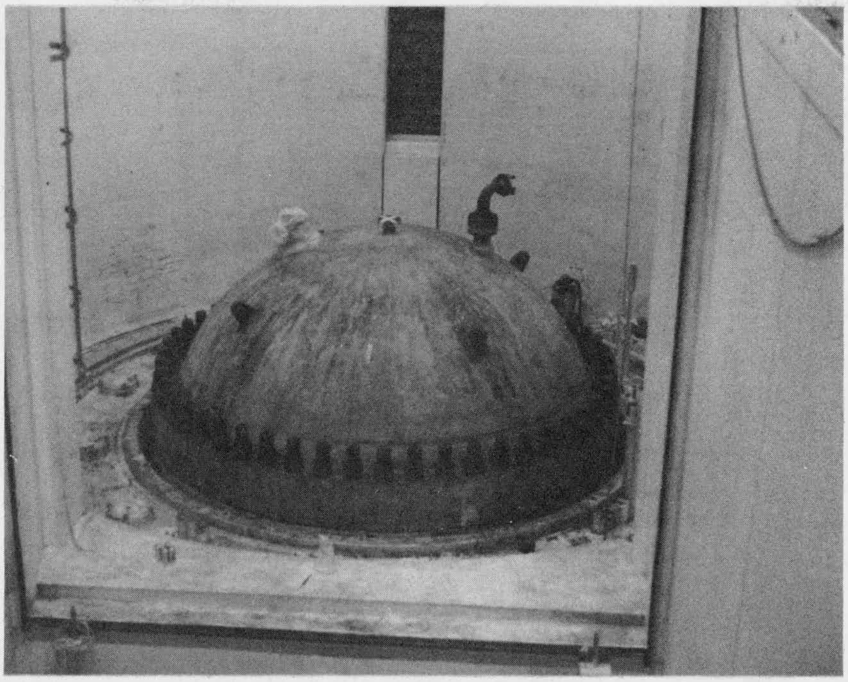


Figure 53. Reactor Pressure Vessel (RPV)

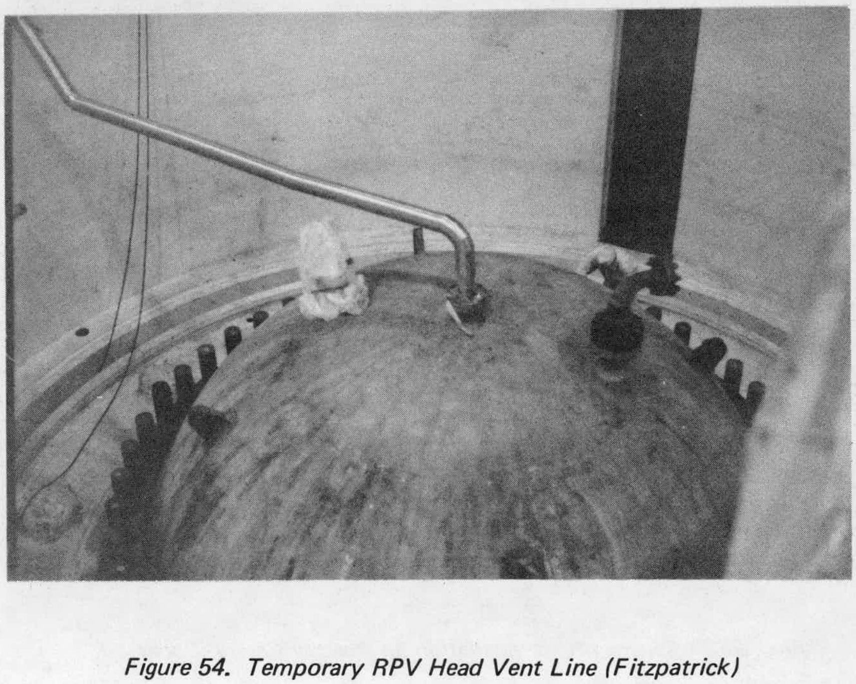


Figure 54. Temporary RPV Head Vent Line (Fitzpatrick)

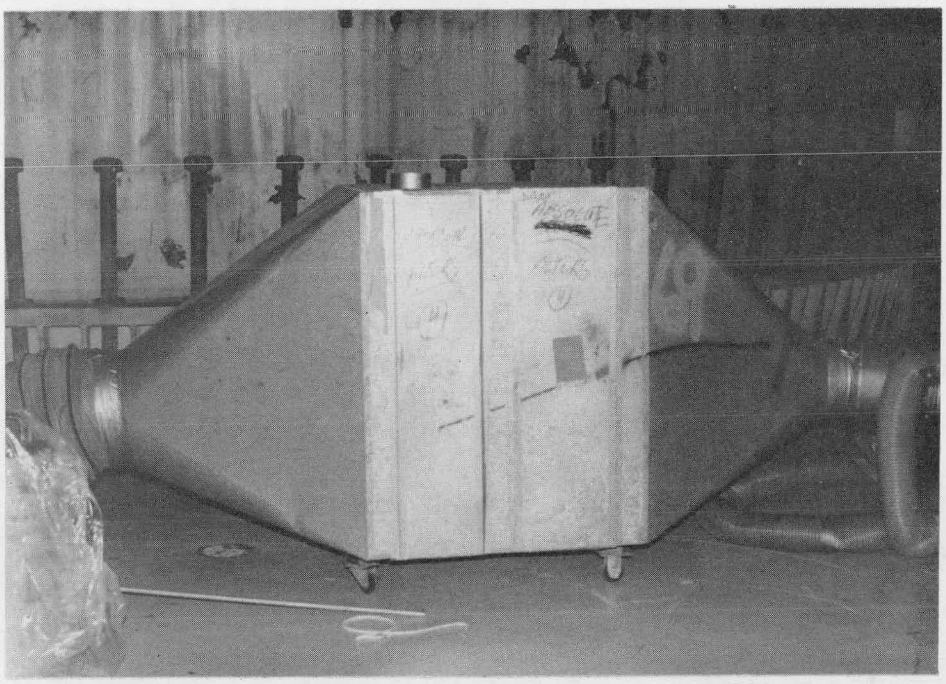


Figure 55. RPV Head Ventline Filter (Quad Cities)

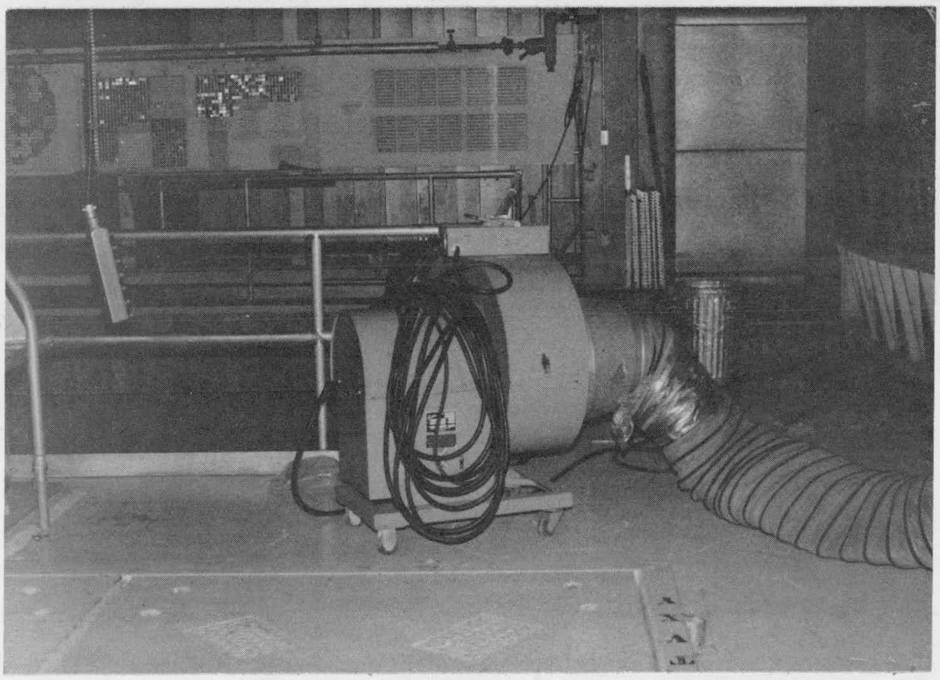


Figure 56. RPV Head Vent Pump (Quad Cities)

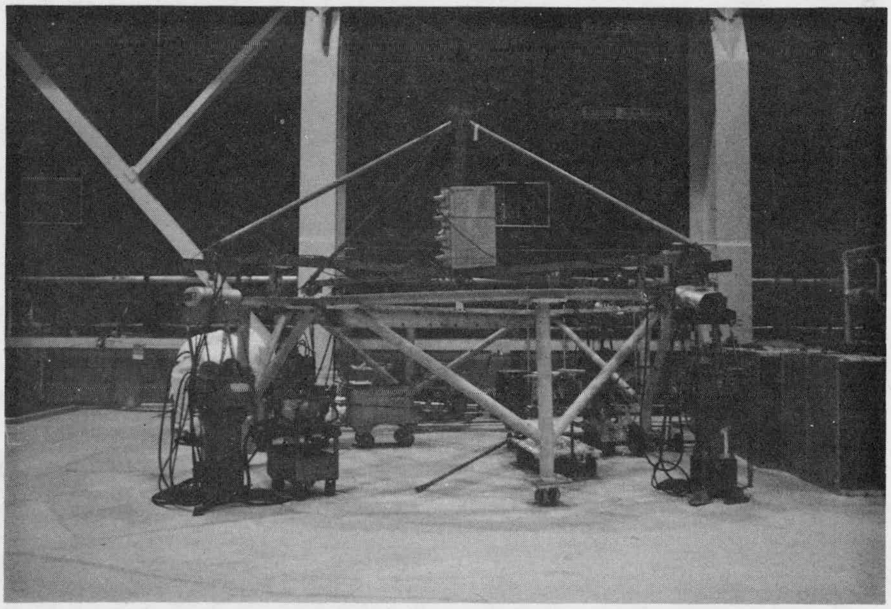


Figure 57. RPV Head Nut Removal Tools on Carousel Assembly (Browns Ferry)

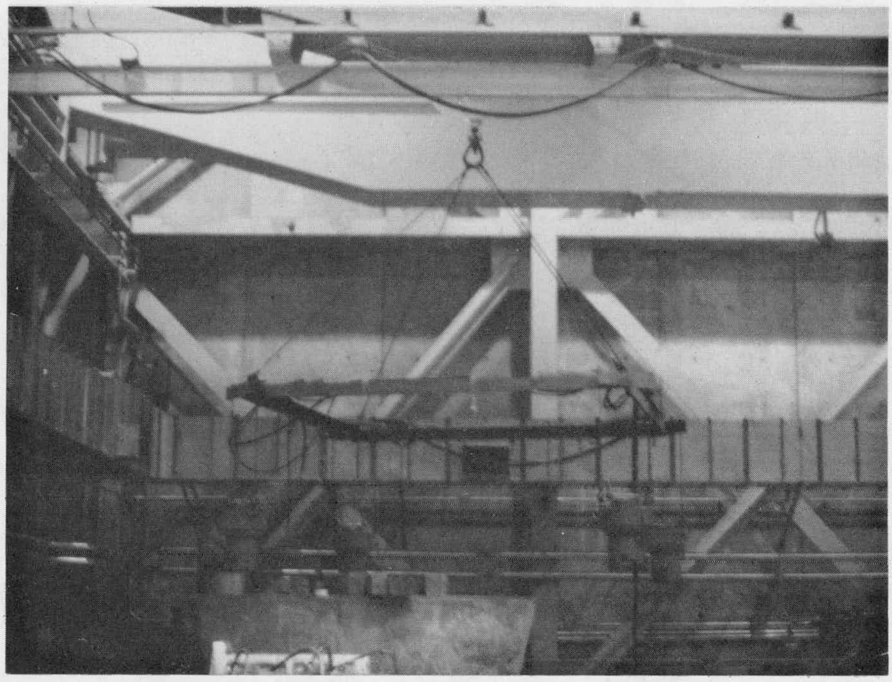


Figure 58. RPV Head Nut Removal Spider Assembly where Tensioners are Fixed. This Requires Lifting and Turning Spider to Detorque all Nuts.

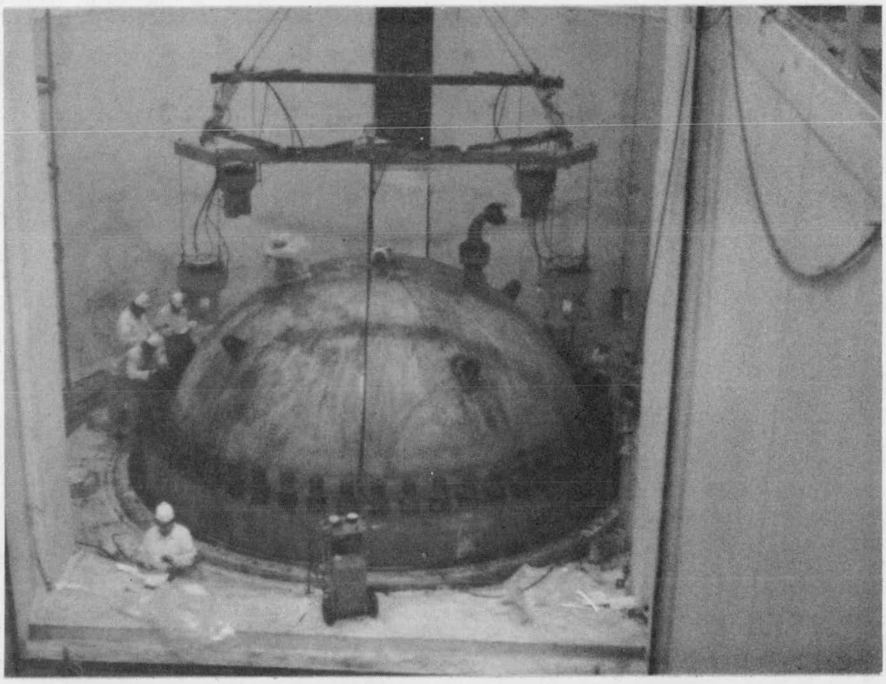


Figure 59. RPV Head Nut Removal Tool on Spider (Browns Ferry)

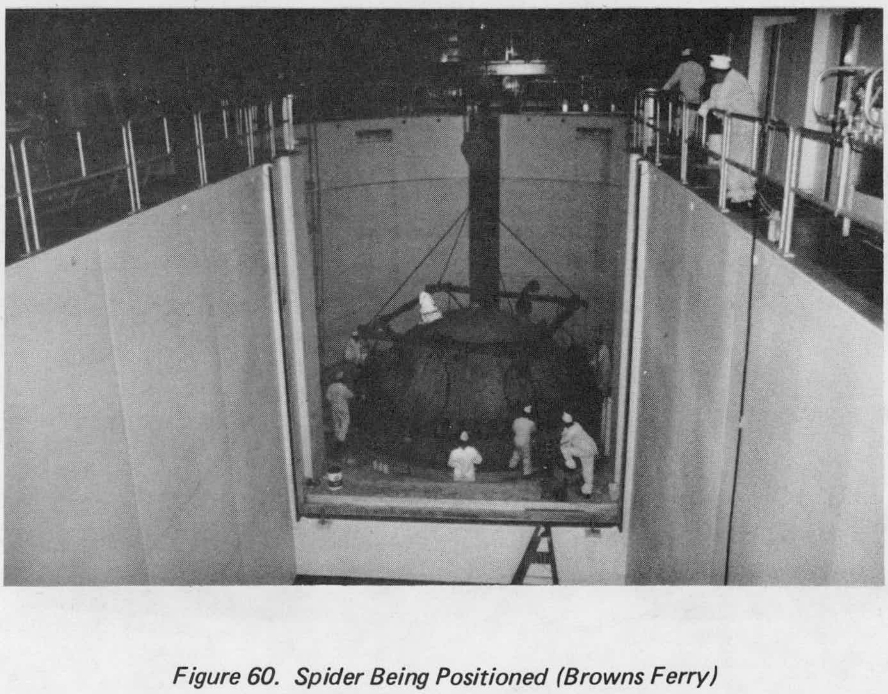


Figure 60. Spider Being Positioned (Browns Ferry)

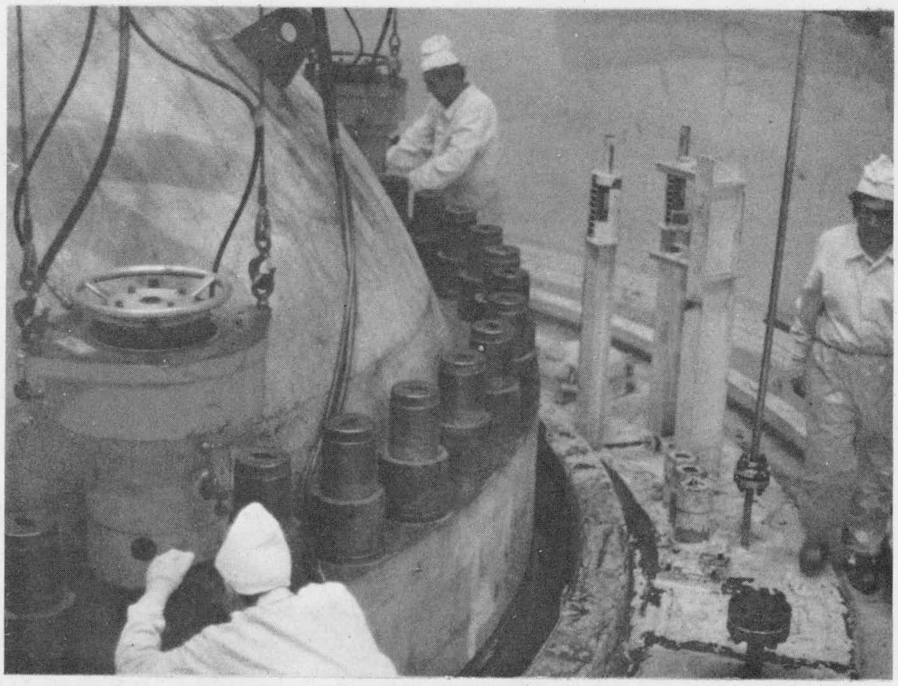


Figure 61. Head Nut Removal (Browns Ferry)

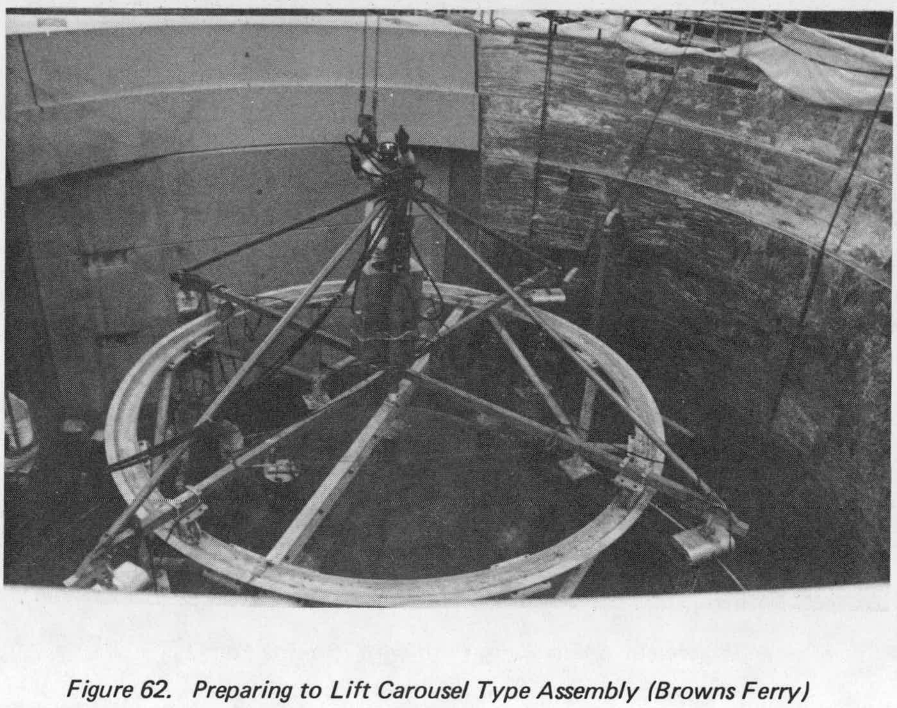


Figure 62. Preparing to Lift Carousel Type Assembly (Browns Ferry)

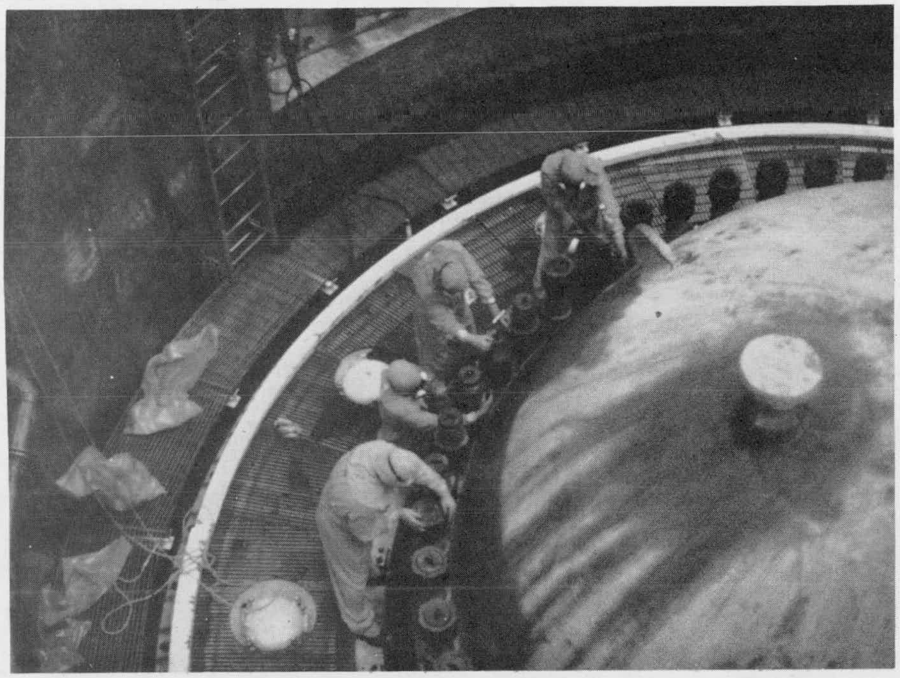


Figure 63. Spinning Off Head Nuts by Hand (Browns Ferry)

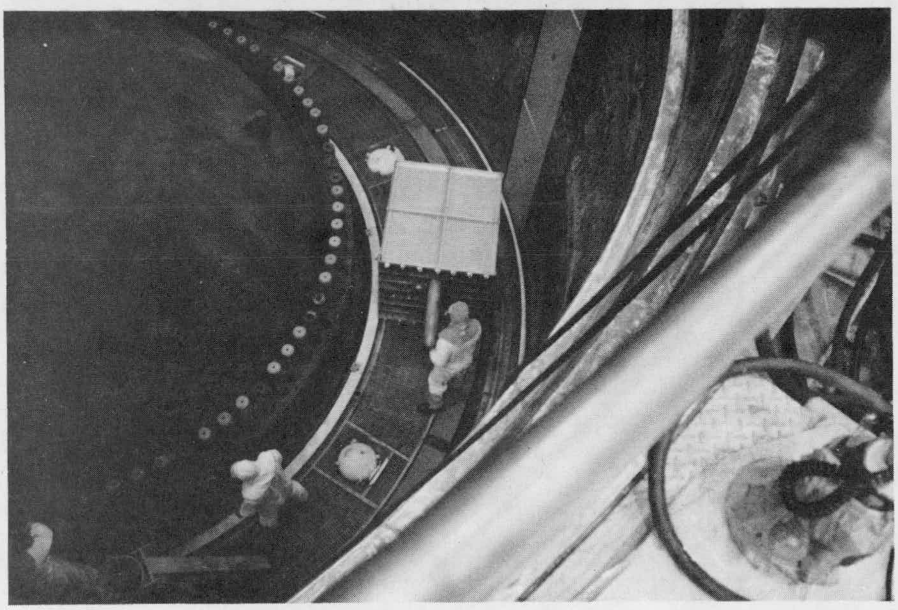


Figure 64. Installing Head Bolt Thread Shield Cylinders (Browns Ferry)

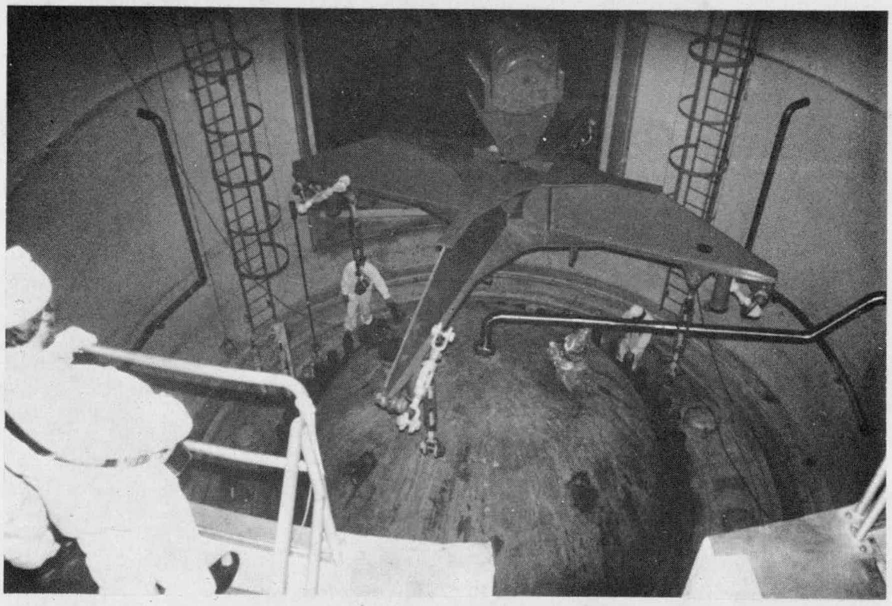


Figure 65. Lowering Head Strong Back to Rig for Lifting Head (Browns Ferry)

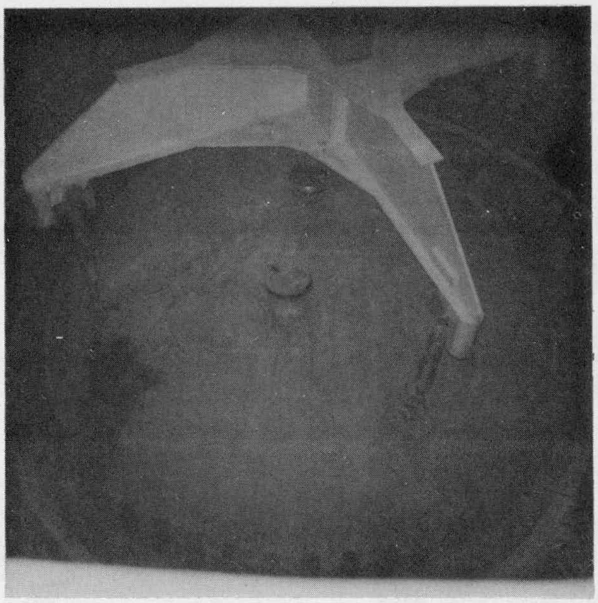


Figure 66. Reactor Head Removal (Hatch)

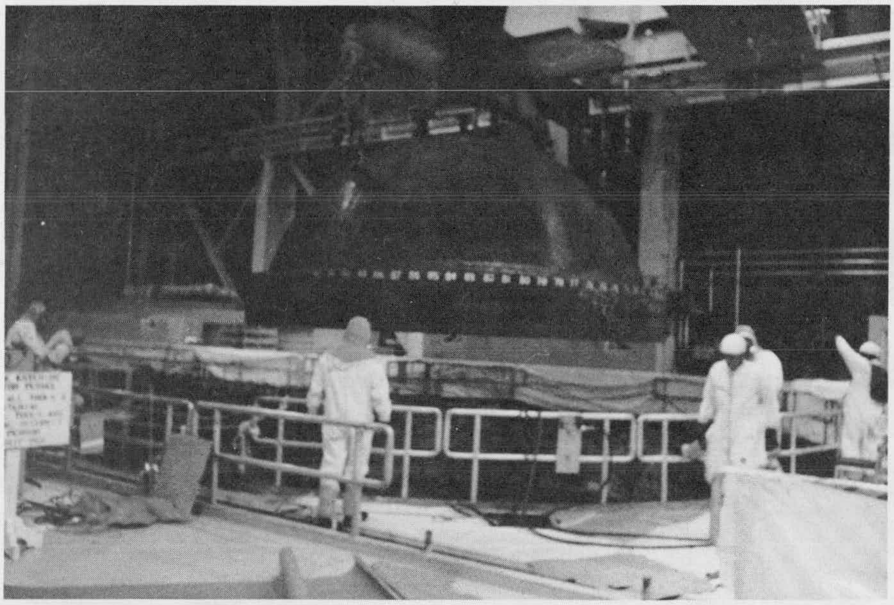


Figure 67. Lifting Head to Clear Refueling Floor Rail (Browns Ferry)

Figure 68. Removing Head Flange O-Ring (Browns Ferry)

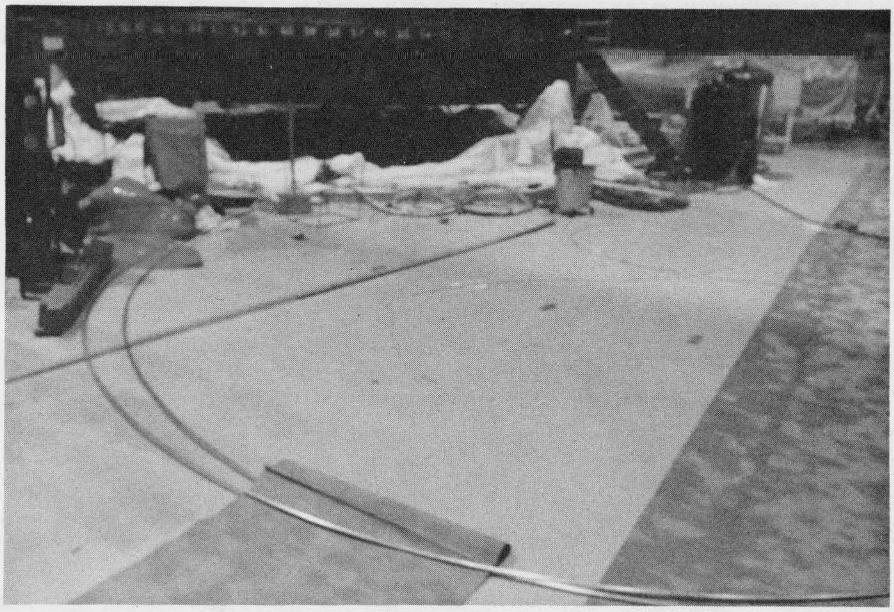


Figure 69. Head Flange O-Ring (Browns Ferry)

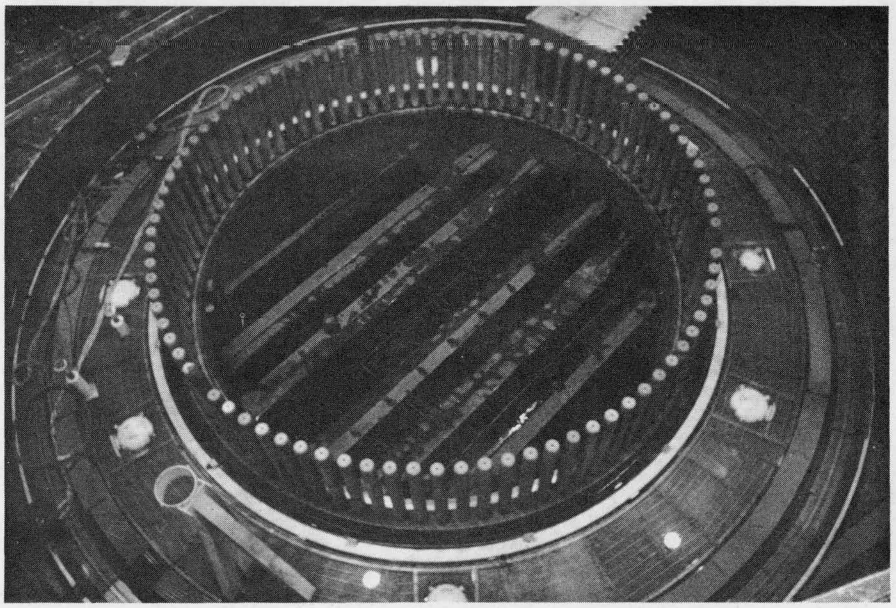


Figure 70. Reactor Open, Dryer Exposed (Browns Ferry)

Figure 71. Removing Reactor Stud Bolts to Install "Cattle Chute" (Hatch)

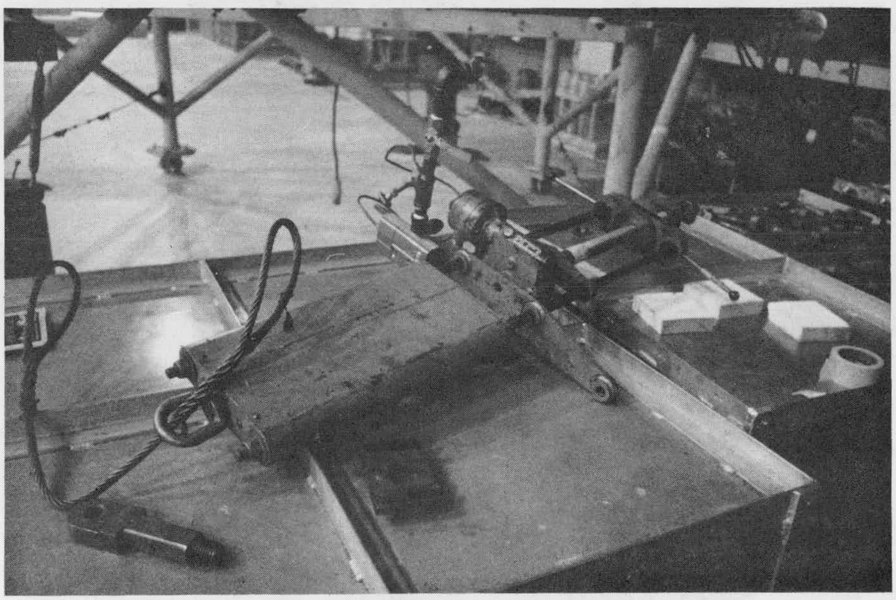


Figure 72. Stud Bolt Slot Removal Tool. Frequent Breakdowns Experienced with this Tool (Browns Ferry)

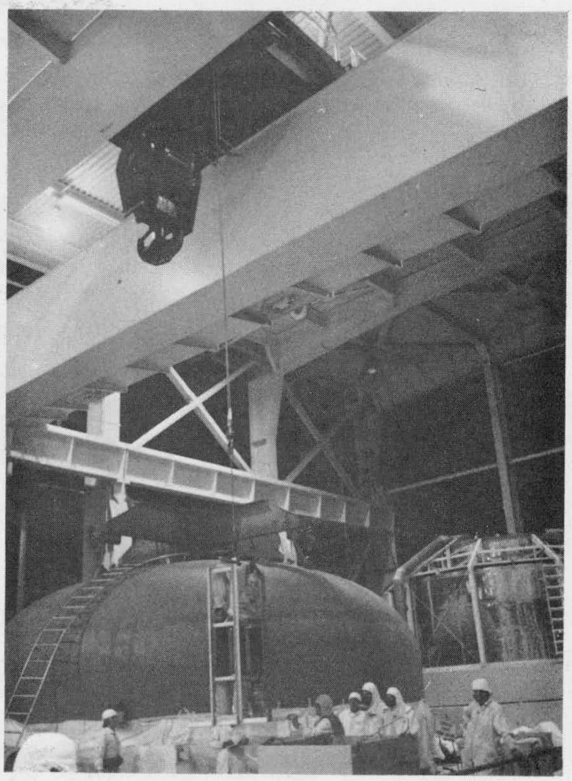


Figure 73. Reactor Pressure Vessel Closure Studs (Browns Ferry)

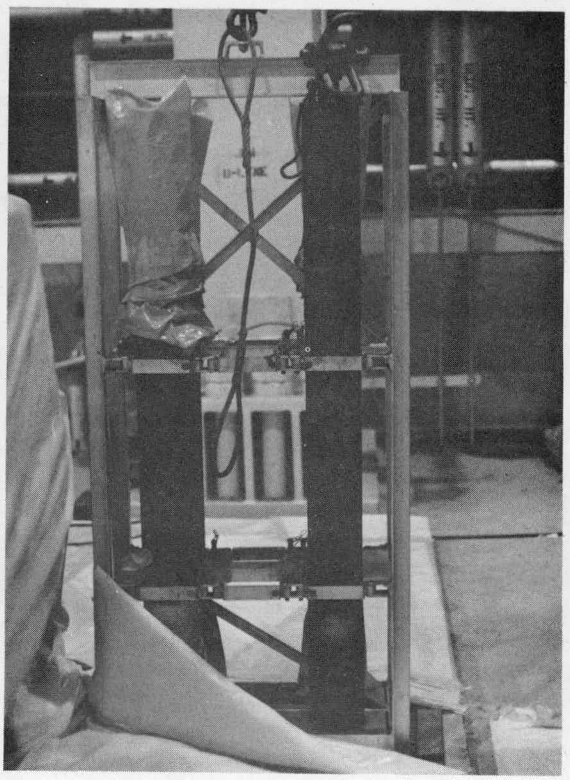


Figure 74. Reactor Pressure Vessel Closure Studs (Browns Ferry)

Figure 75. Reactor Pressure Vessel Closure Studs (Hatch)

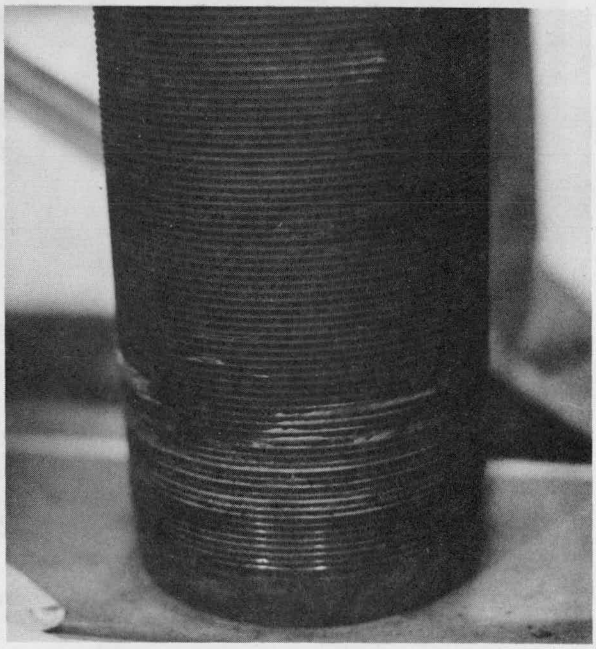


Figure 76. Reactor Pressure Vessel Closure Studs (Browns Ferry)

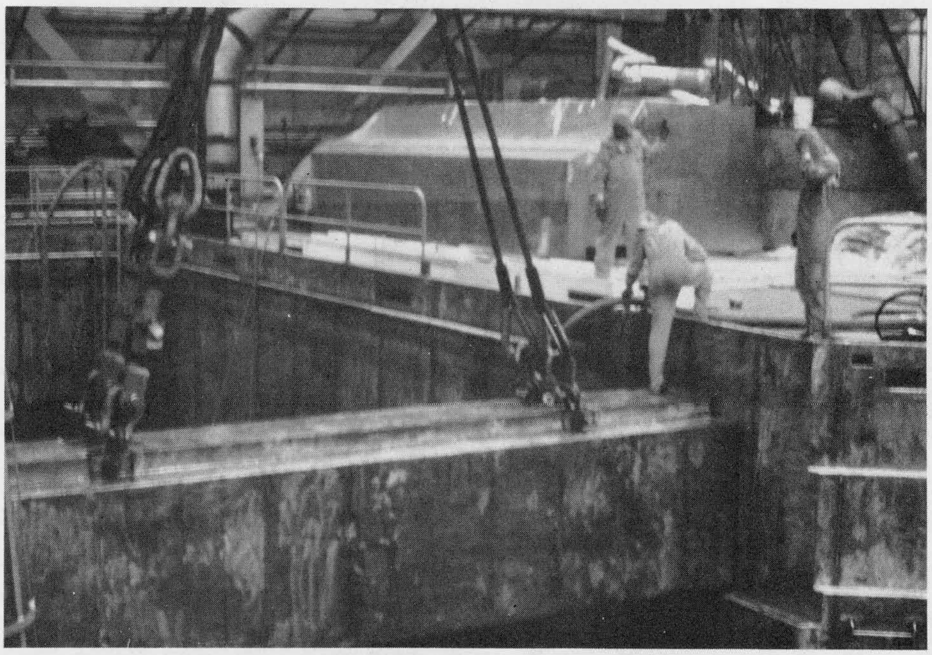


Figure 77. Lifting Equipment Pool Shield Blocks

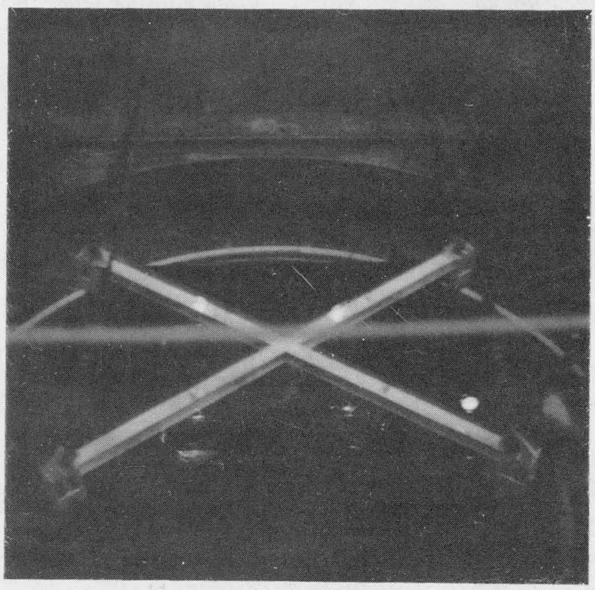


Figure 78. Dryer Strong Back Rigged to Lift Dryer (Hatch)

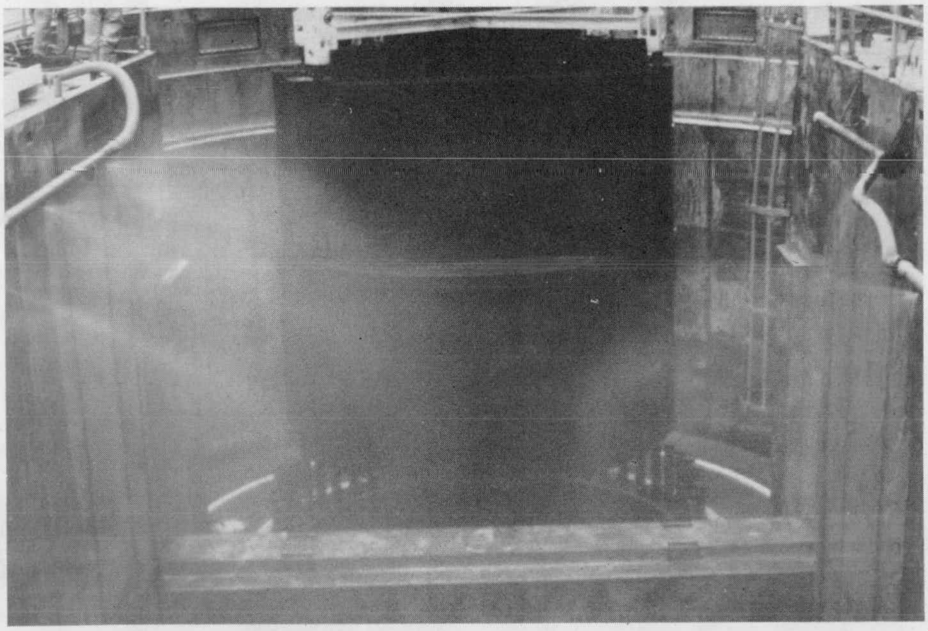


Figure 79. Lifting Dryer from RPV - Note Equipment Pool Spray

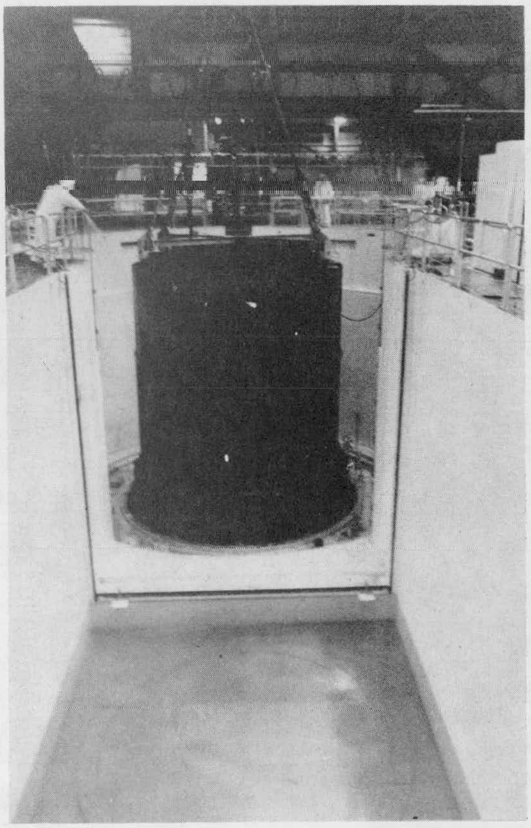


Figure 80. Hosing Down Dryer (Fitzpatrick)

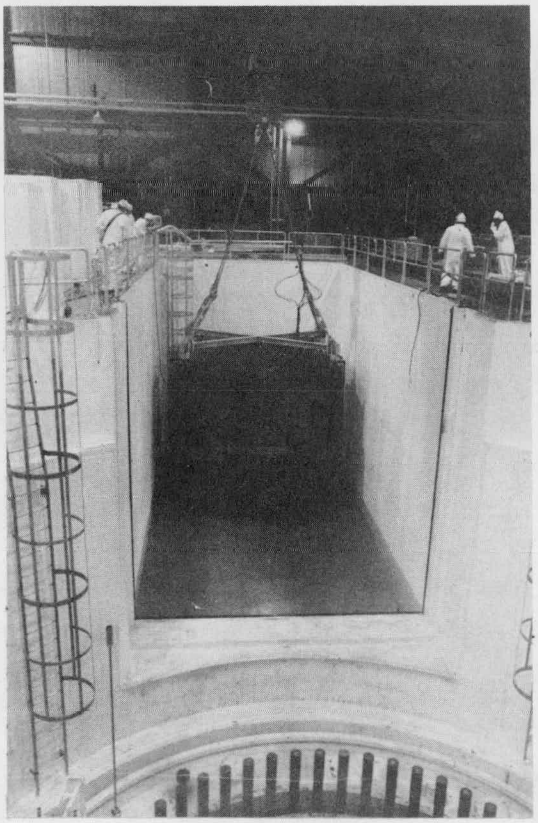


Figure 81. Placing Dryer in Equipment Pool (Fitzpatrick)

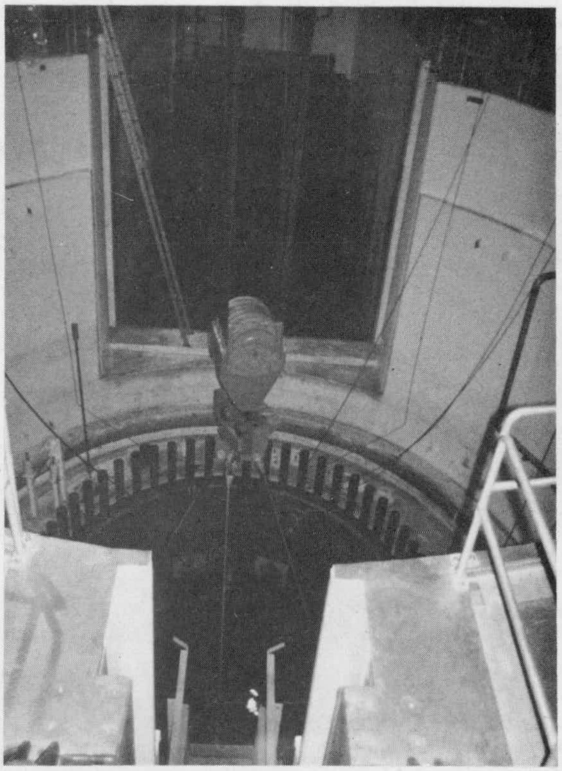


Figure 82. Removal of Shroud Head and Separator (Fitzpatrick)

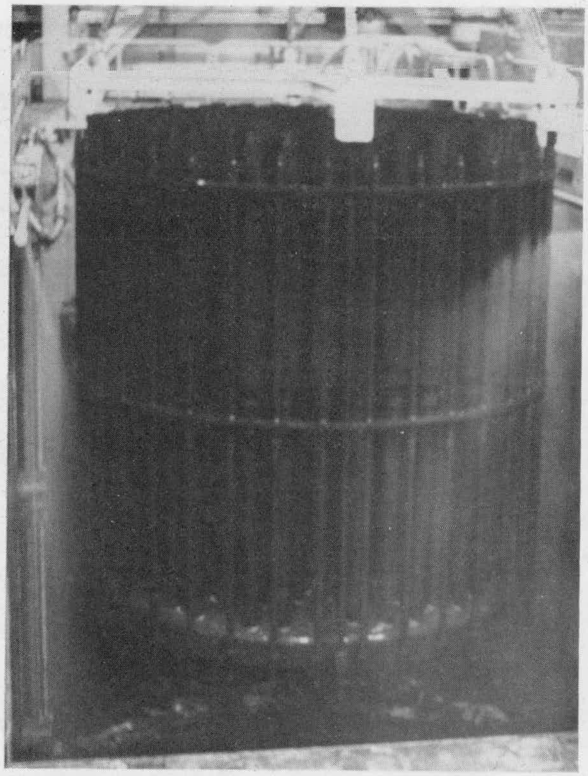


Figure 83. Removal of Shroud Head and Separator (Fitzpatrick)

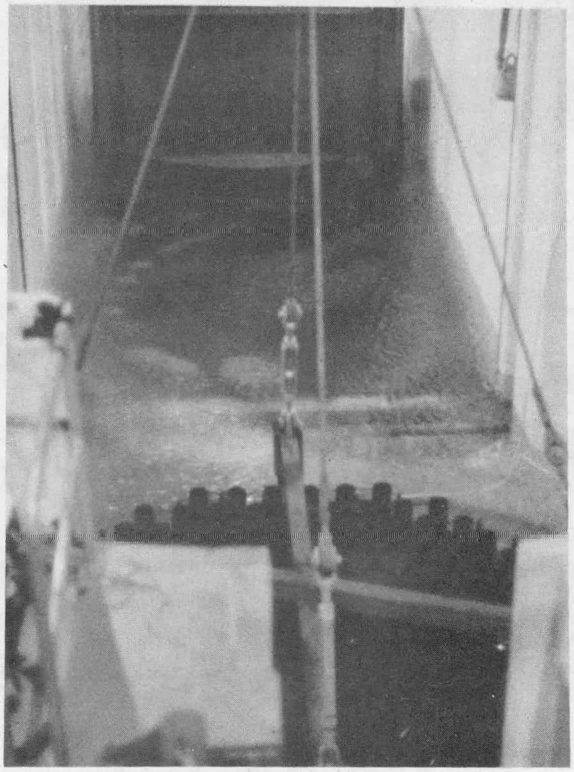


Figure 84. Removal of Shroud Head and Separator (Browns Ferry)

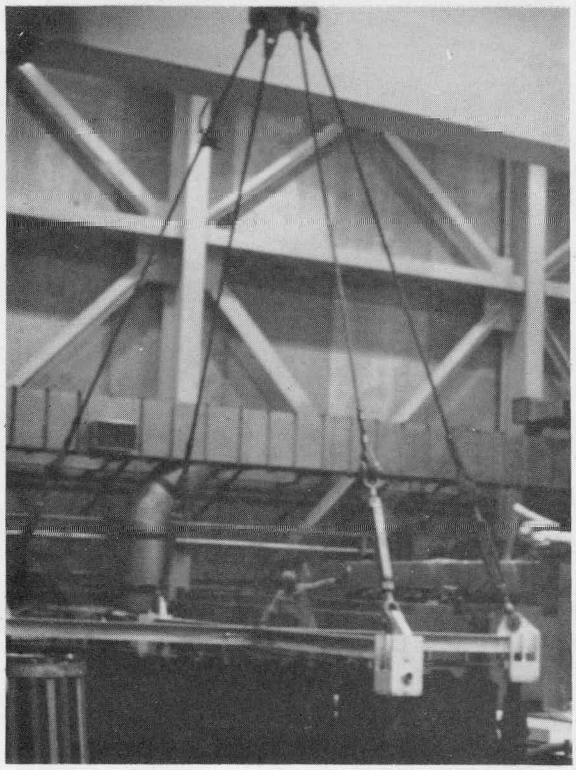


Figure 85. Removal of Shroud Head and Separator (Browns Ferry)

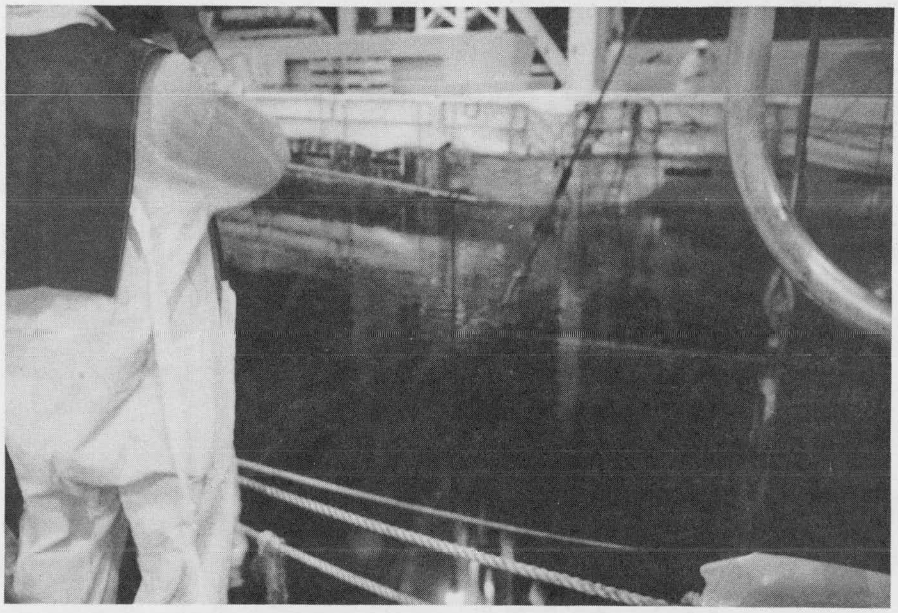


Figure 86. Lifting Separator Under Water (Browns Ferry)

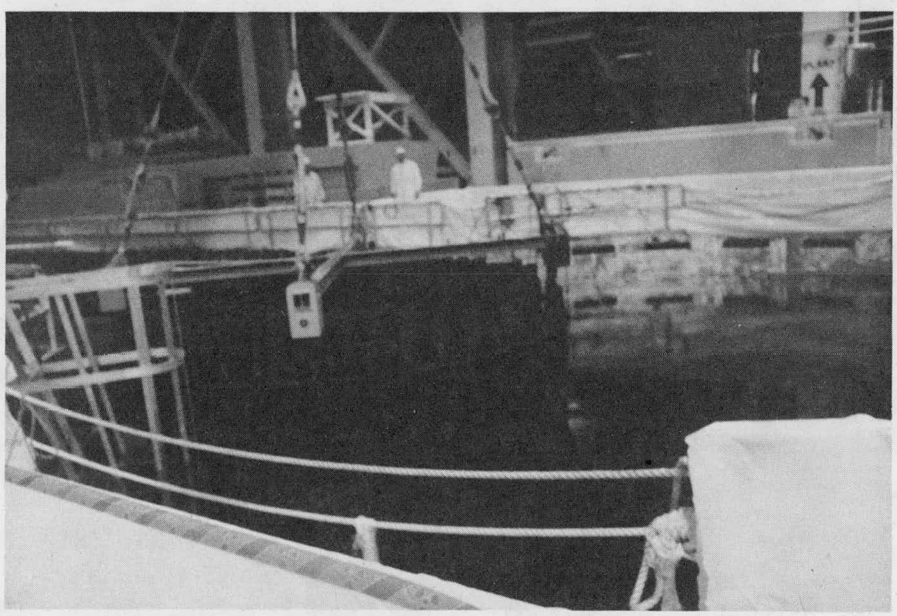


Figure 87. Moving Separator Into Equipment Pool (Browns Ferry)

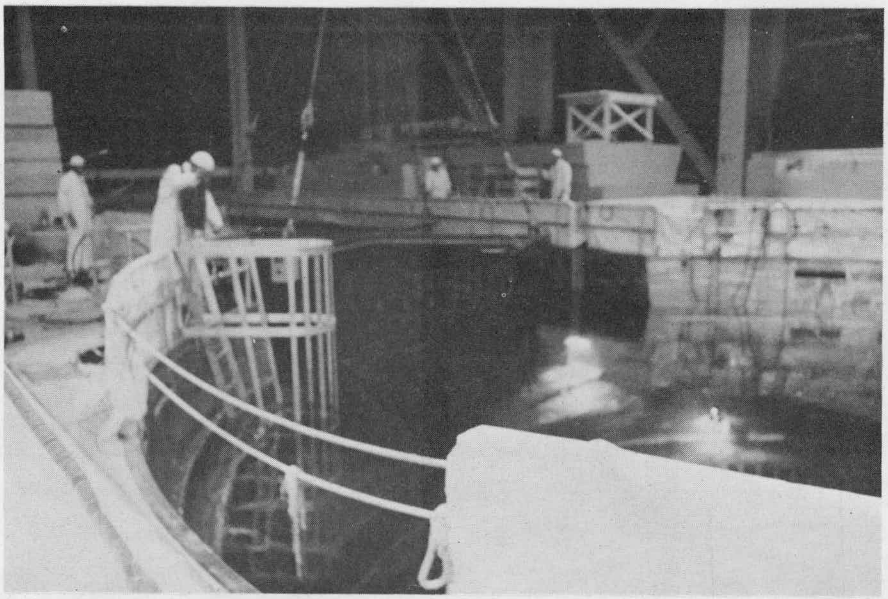


Figure 88. Placing Separator in Equipment Pool (Browns Ferry)

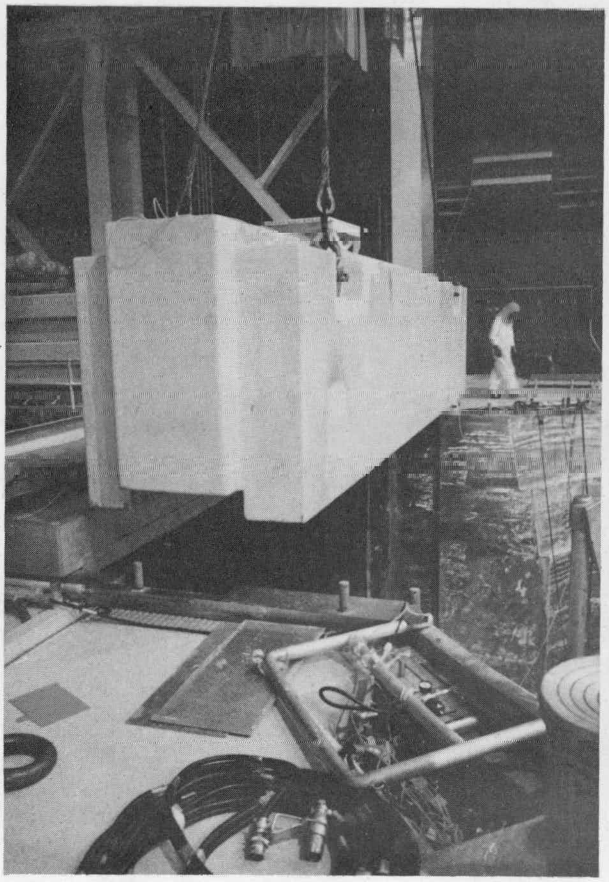


Figure 89. Installing Equipment Pool Shield Block (Browns Ferry)

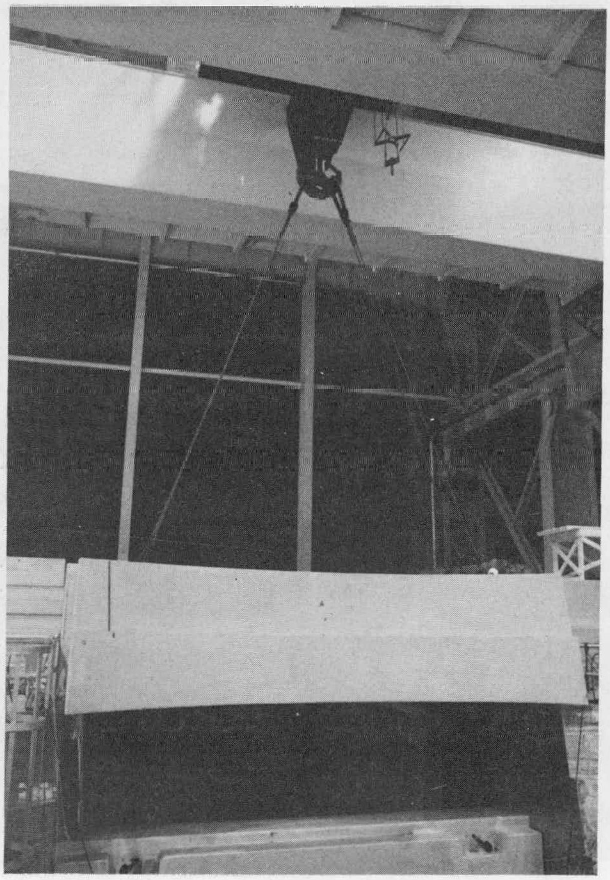


Figure 90. Installing Top Shield Block (Browns Ferry)

Figure 91. Installing Equipment Pool Seal Gate (Reactor Cavity Side) (Browns Ferry)

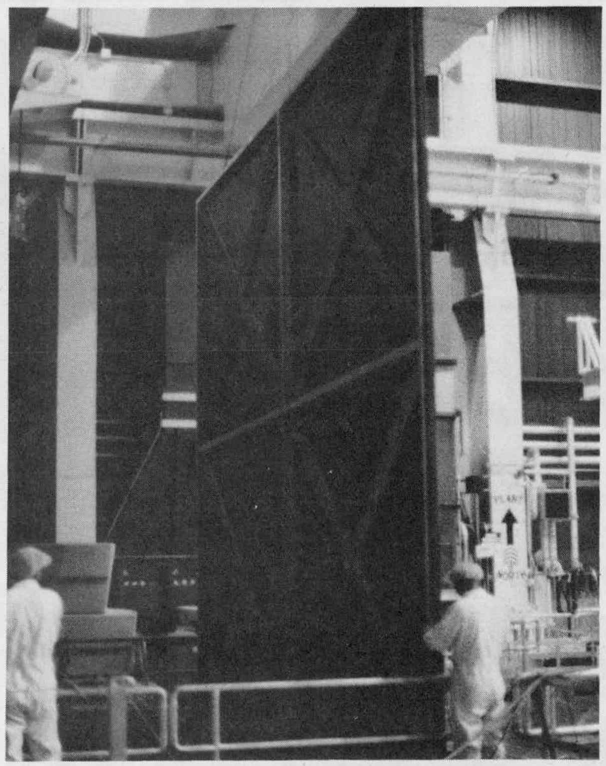


Figure 92. Removing Equipment Pool Seal Gate to Repair Seal Leakage (Browns Ferry)

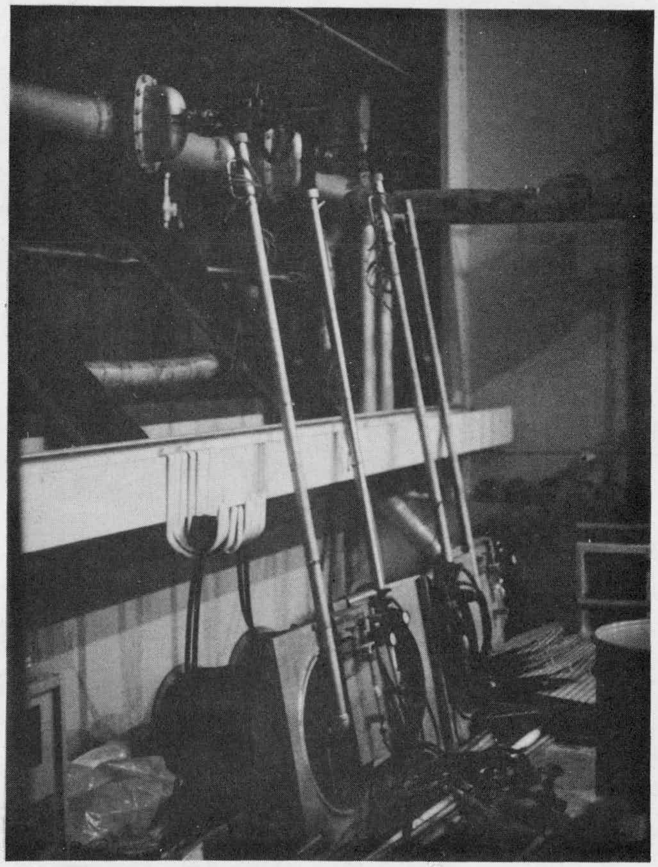


Figure 93. Main Steam Line Plugs - Note Tie Lines Used Because Upper Latch Would Not Latch Due to Bending of Installation Jig. (Browns Ferry)

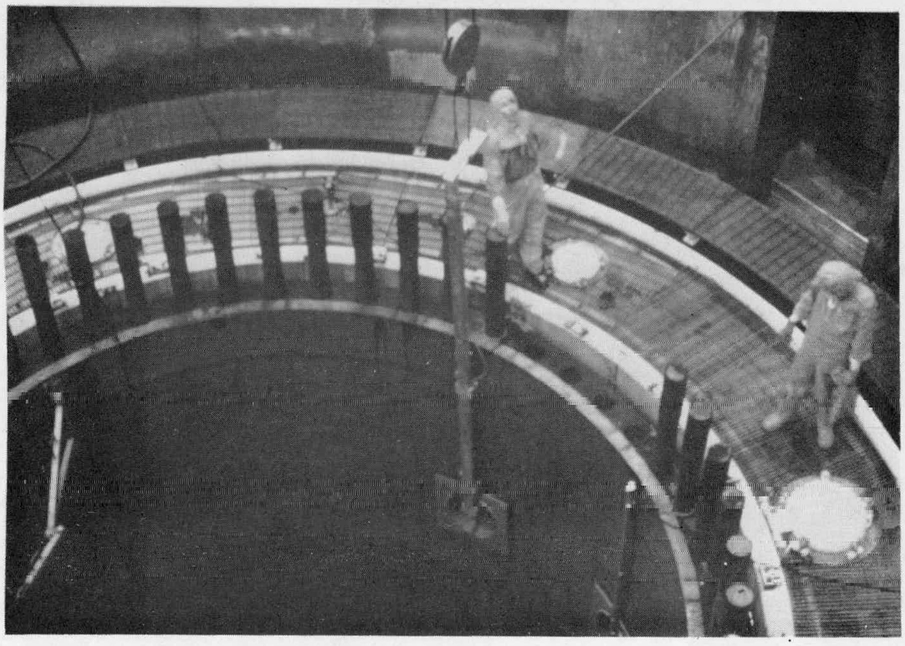


Figure 94. Installing Steam Line Plugs in RPV - Use of Auxiliary Crane Causes Undue Strain on Installation Jig (Browns Ferry)

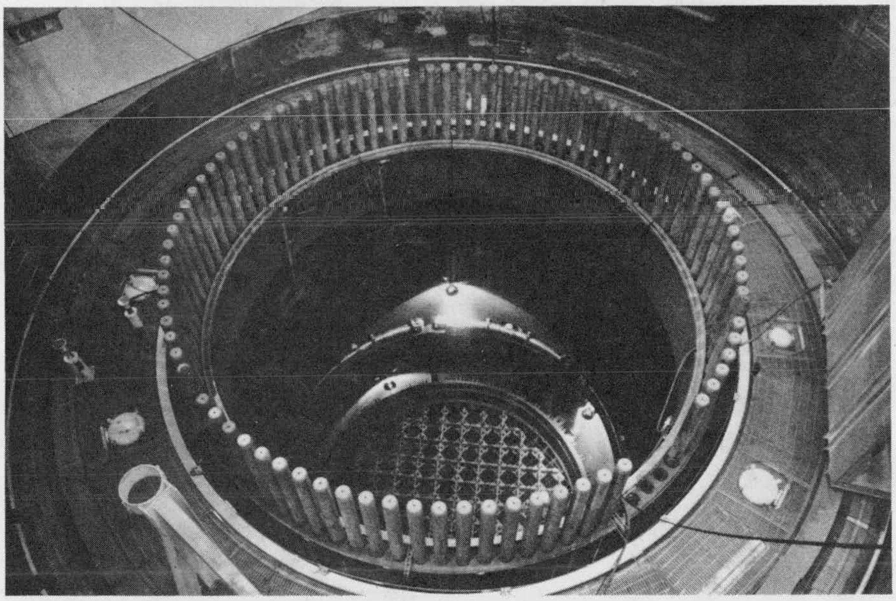


Figure 95. RPV, Feedwater Spargers (Below Middle Light) and Core Top Guide (Browns Ferry)

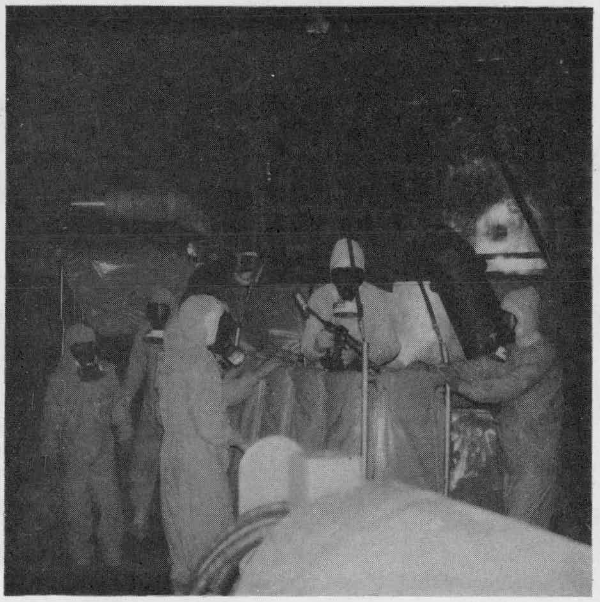


Figure 96. Personnel in Crane Skip Preparing to Hydrolase Reactor Cavity

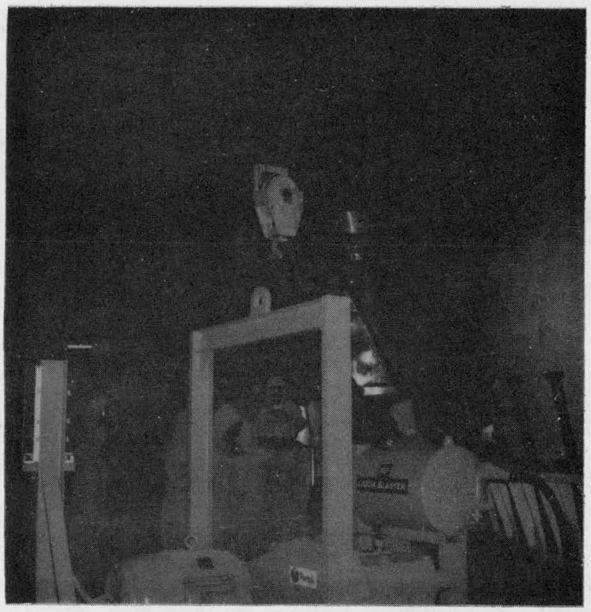


Figure 97. Hydrolaser Pump (Hatch)

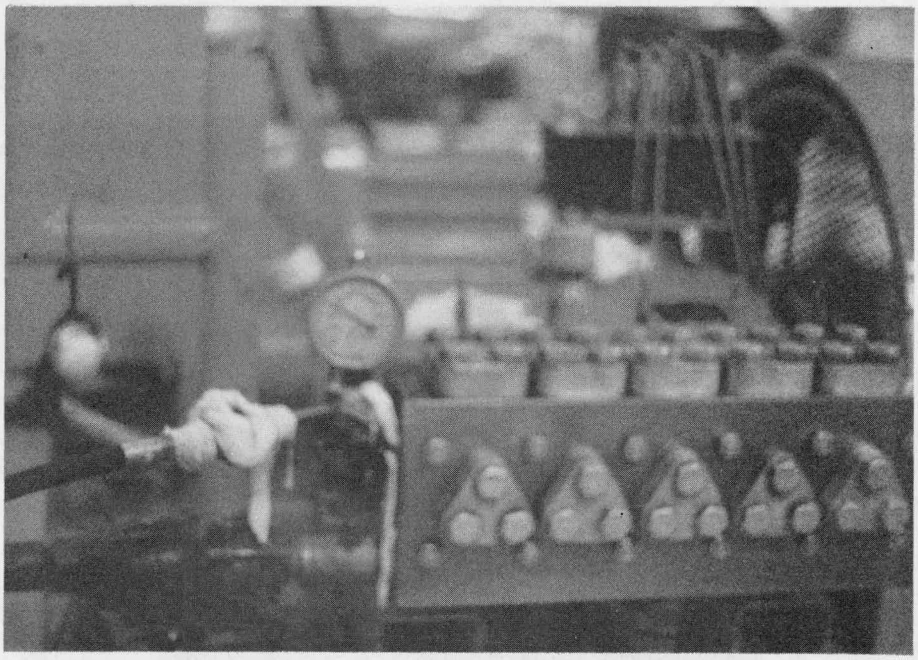


Figure 98. Hydrolaser (Fitzpatrick)

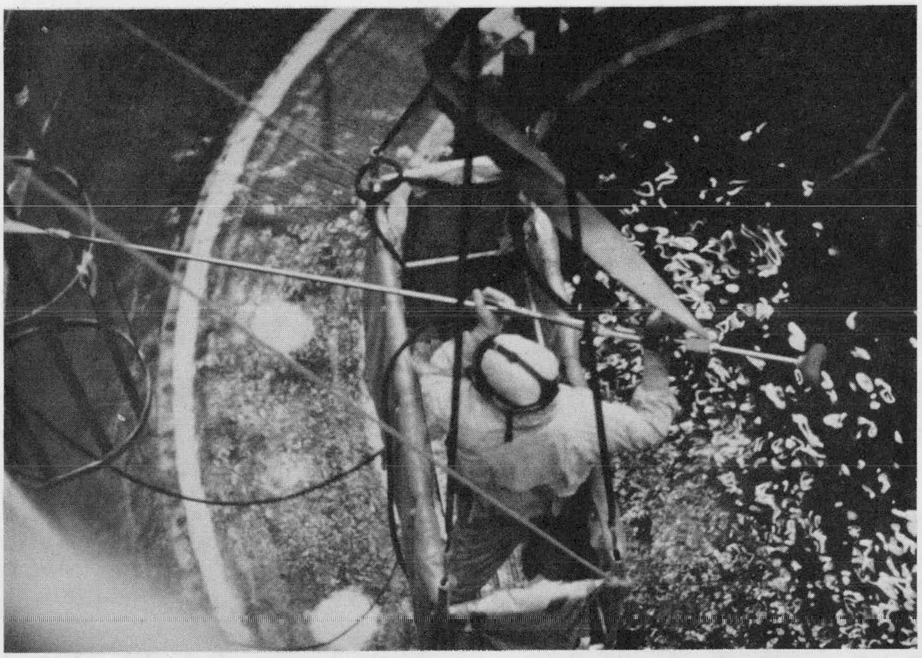


Figure 99. Decontaminating Reactor Well with Hydrolaser - Operator Should Have a 30° to 40° Down Angle (Browns Ferry)

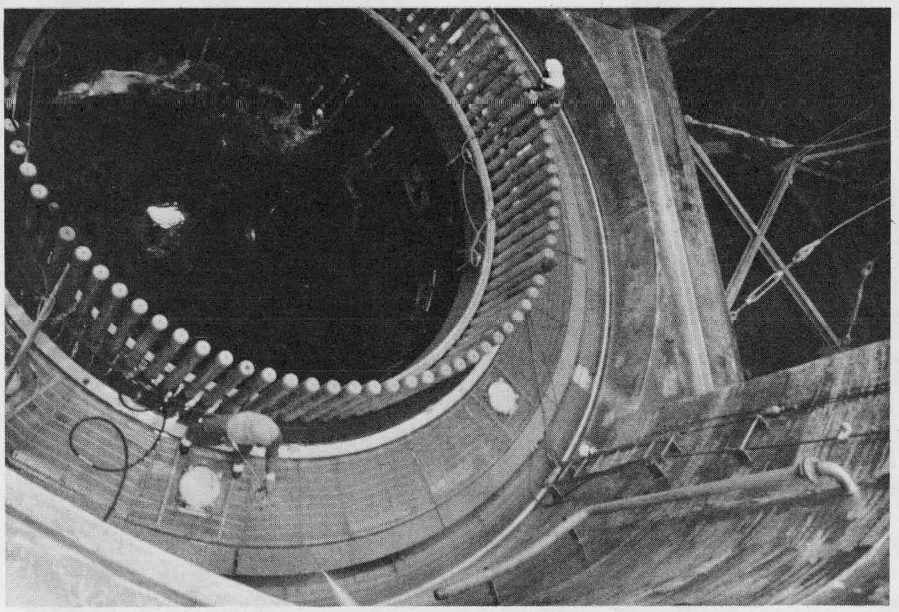


Figure 100. Operator Should Have Hydrolaser About Twelve Inches from Wall and 30° to 40° Down Angle (Browns Ferry)

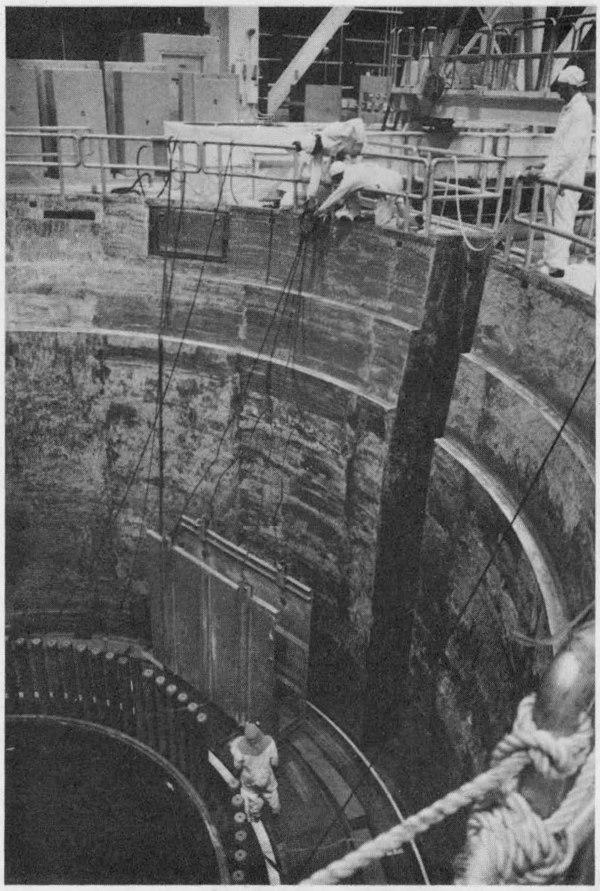


Figure 101. In Process of Attaching Cattle Chute Sling to Crane (Browns Ferry)

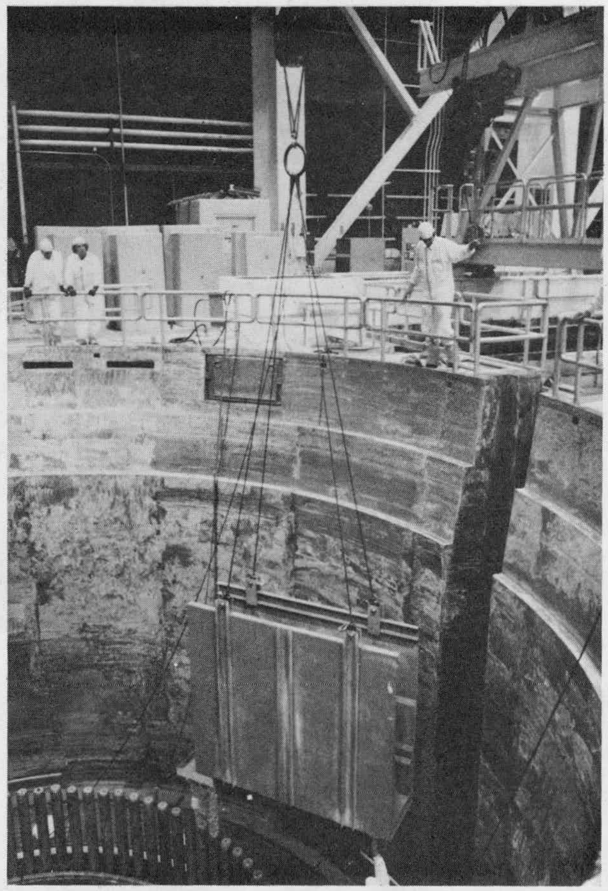


Figure 102. Installing Cattle Chute into Refueling Slot - Main Crane Being Used (Browns Ferry)

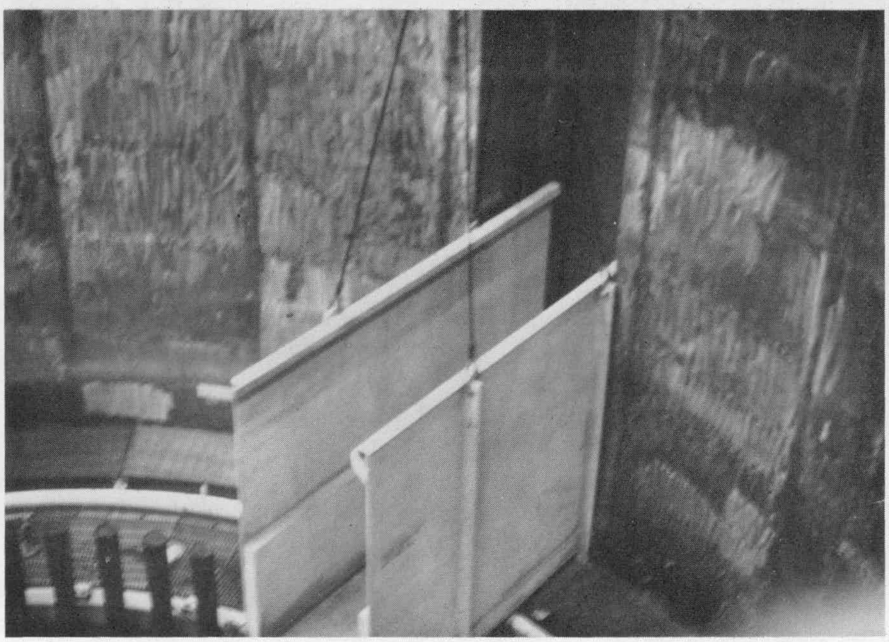


Figure 103. Cattle Chute Set in Position (Browns Ferry)

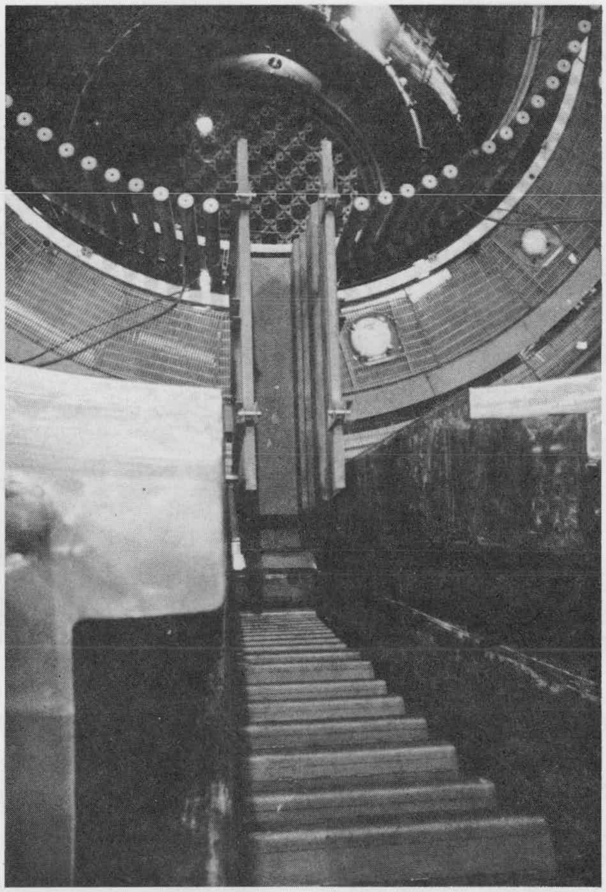


Figure 104. Fuel Pool Shield Blocks Removed - Cattle Chute in Position - Fuel Pool Gate in Position - Ready to Flood Reactor Well (Browns Ferry)

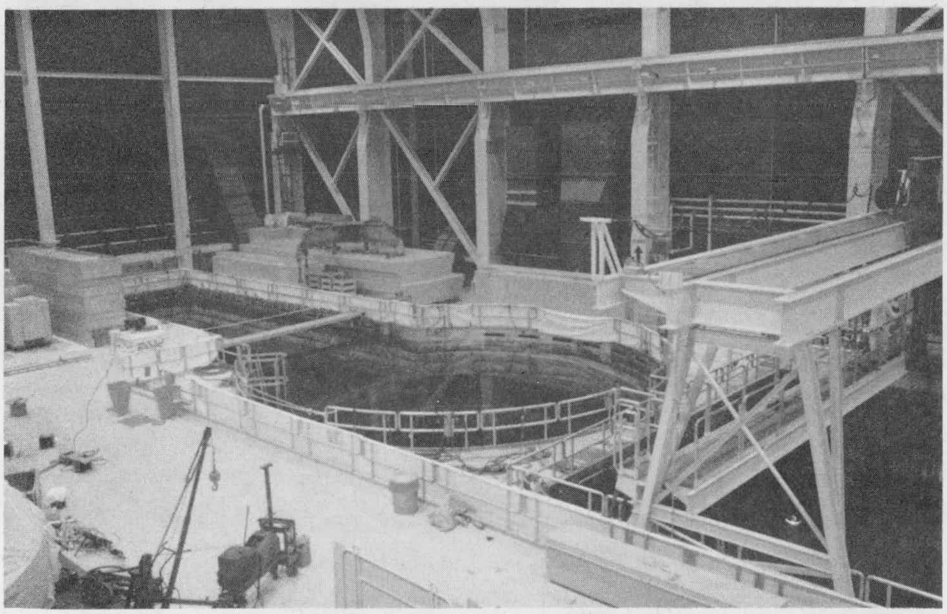


Figure 105. Reactor Well Flooded Ready to Unload Fuel (Browns Ferry)

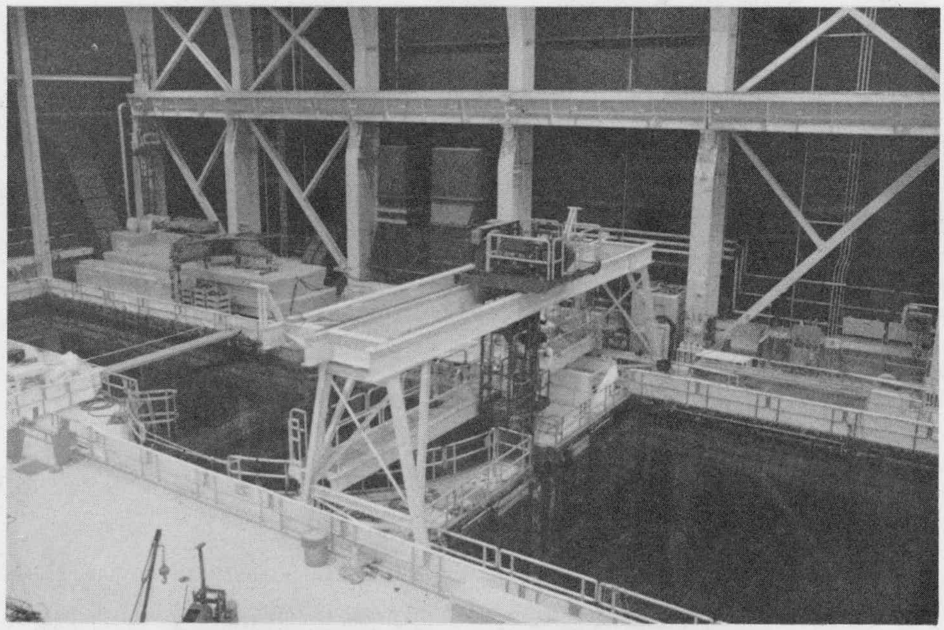


Figure 106. Refueling Bridge Moving Over Reactor Core (Browns Ferry)

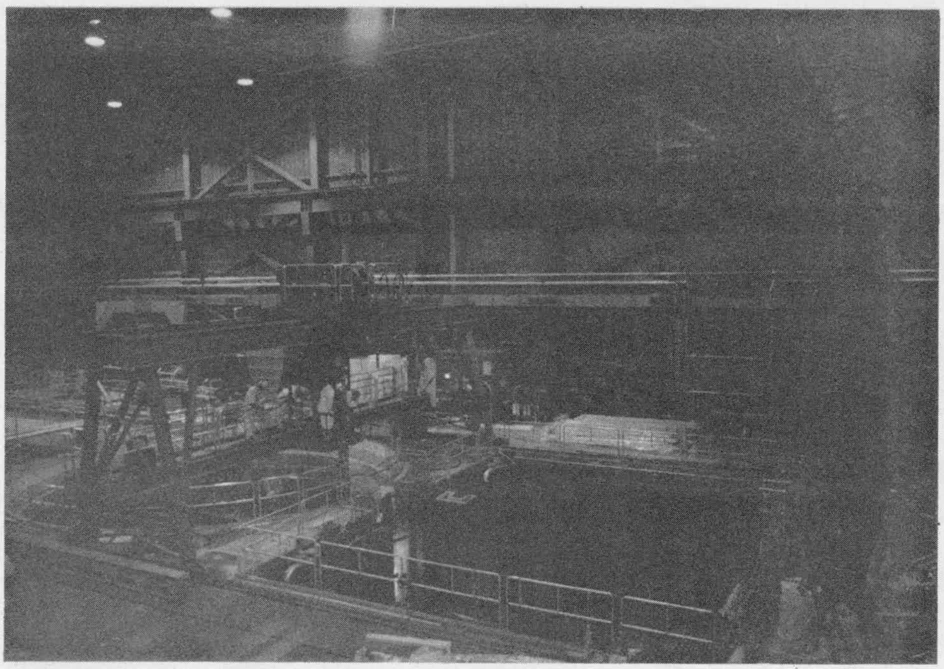


Figure 107. Latching on to a Fuel Bundle (Fitzpatrick)

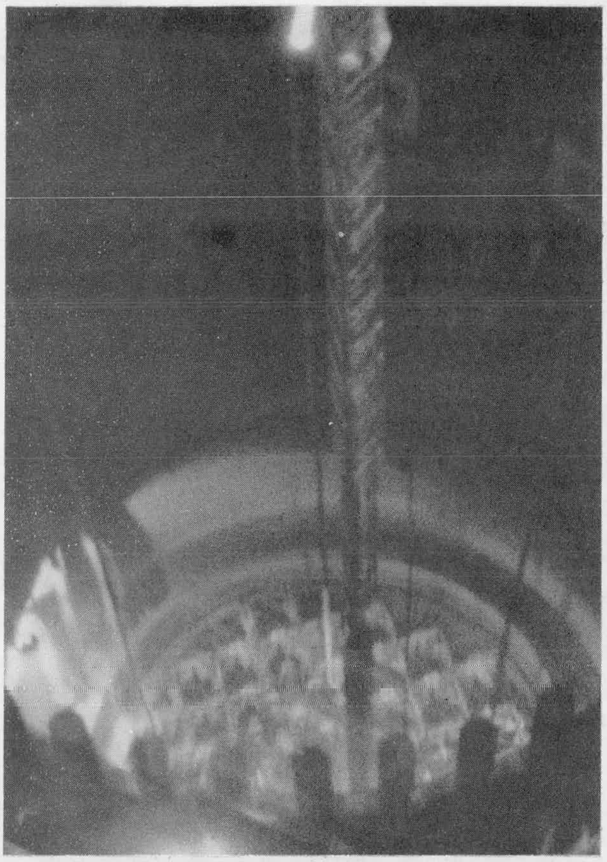


Figure 108. Fuel Grapple and Fuel Bundle (Fitzpatrick)

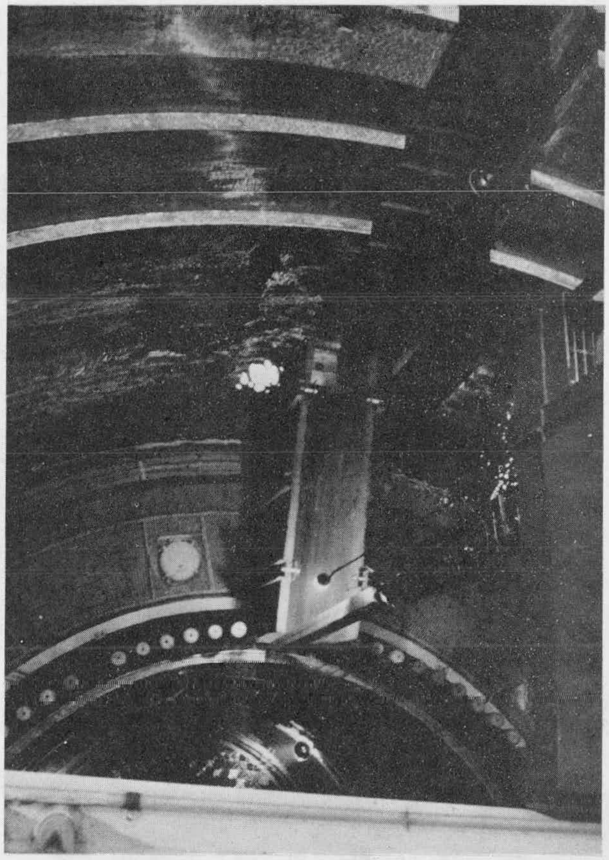


Figure 109. Transferring Fuel Bundle from Core to Fuel Storage Pool (Browns Ferry)

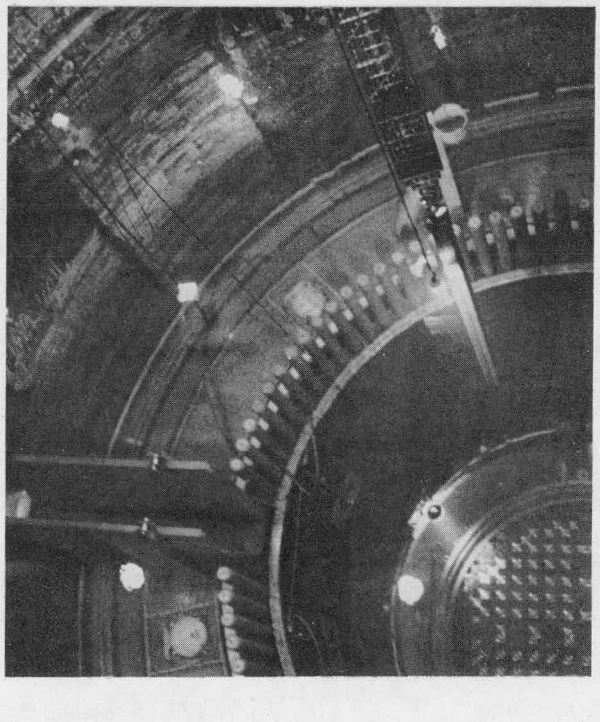


Figure 110. Refueling Bridge Moving Toward the Cattle Chute

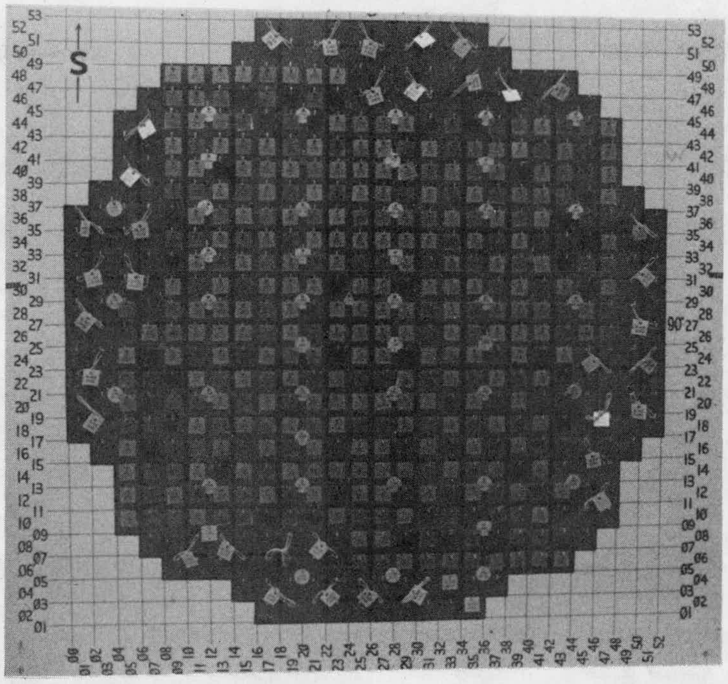


Figure 111. Refueling Plot Board in Control Room (Fitzpatrick)

Figure 112. Fuel Bundle in Cattle Chute

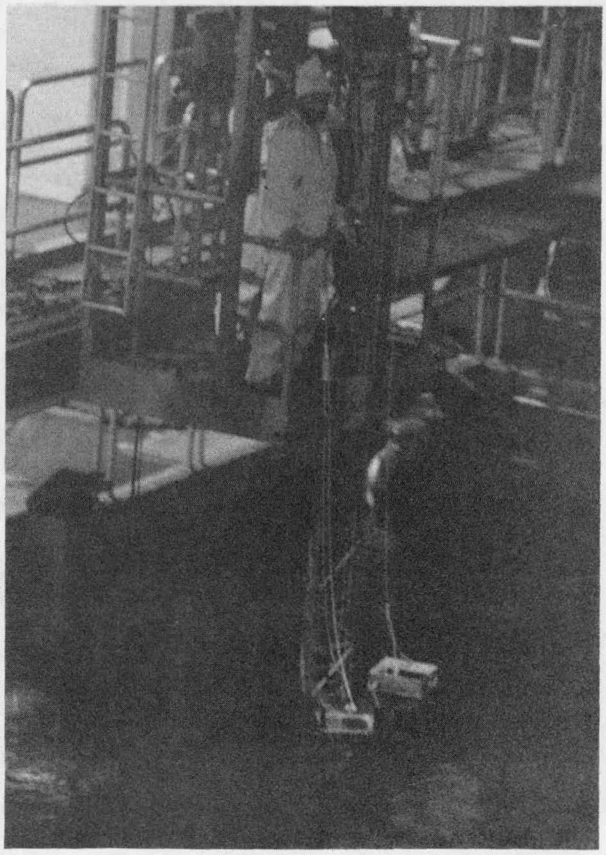


Figure 113. Refueling Bridge Console and Floating View Boxes - Corners of Viewing Boxes Interferred with Grapple Telescoping Action Frequently (Fitzpatrick)

Figure 114. Fuel Bundle Being Placed in Fuel Rack

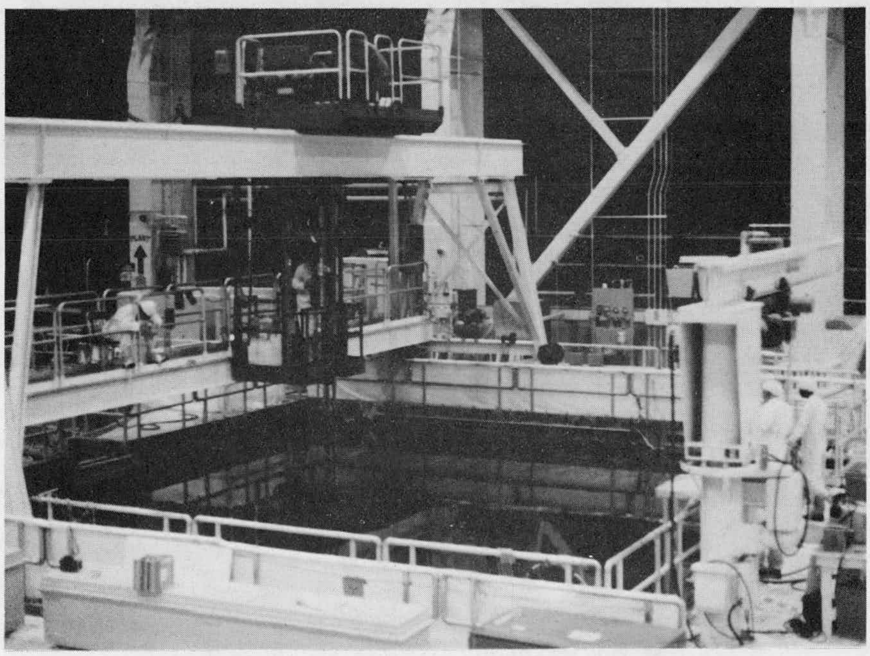


Figure 115. Refueling Bridge Over the Fuel Storage Pool (Browns Ferry)

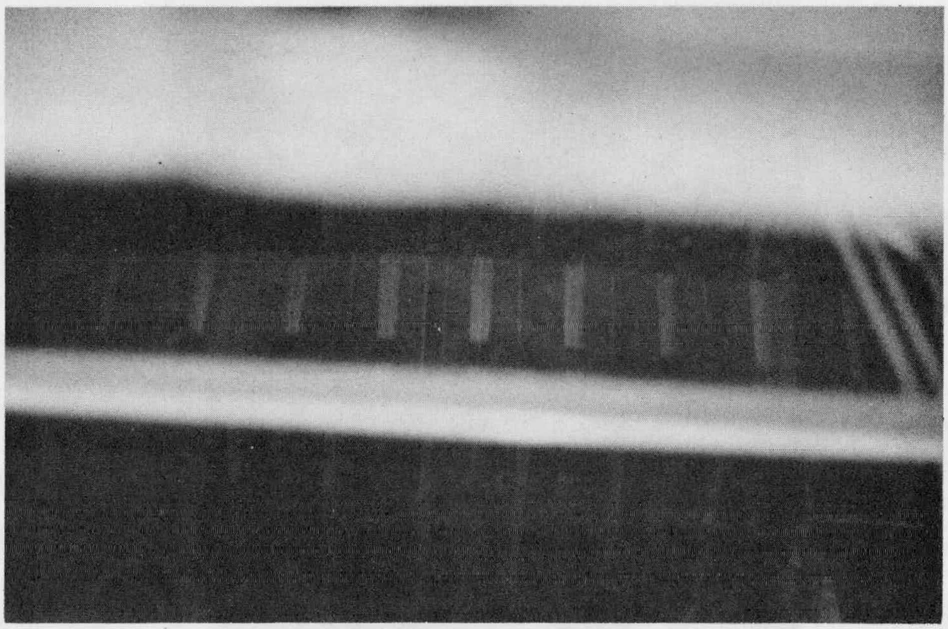


Figure 116. Fuel Storage Pool Showing Irradiated Fuel in Storage Racks (Browns Ferry)

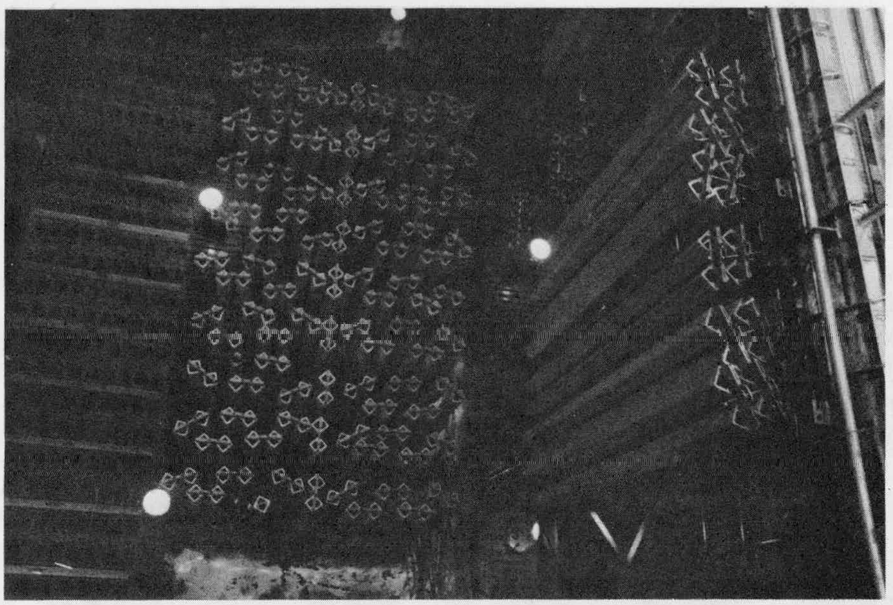


Figure 117. Fuel Storage Pool Showing Blade Guides Hanging on Wall and in Storage Racks on Pool Floor

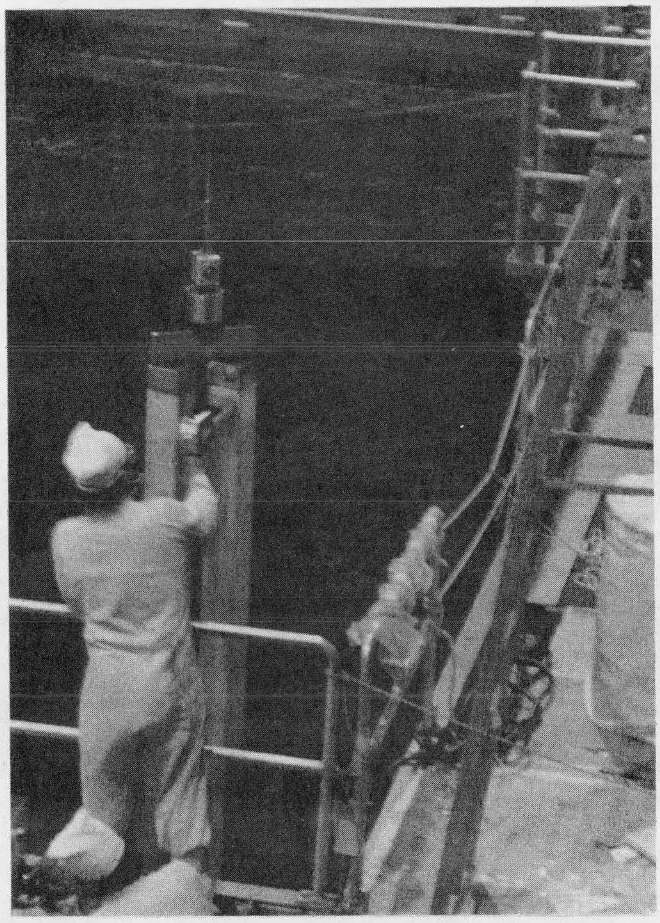


Figure 118. Health Physic Personnel using Cutie-Pie to Read Radiation of a Blade Guide (Fitzpatrick)

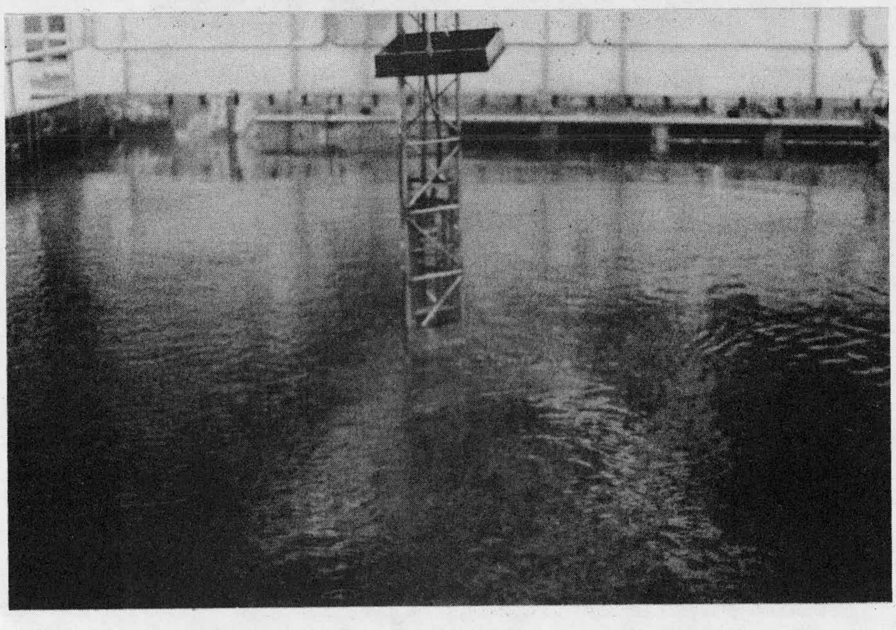


Figure 119. Viewing Boxes were Lifted or Guided During Grapple Transit to Avoid Entanglement in Grapple (Browns Ferry)

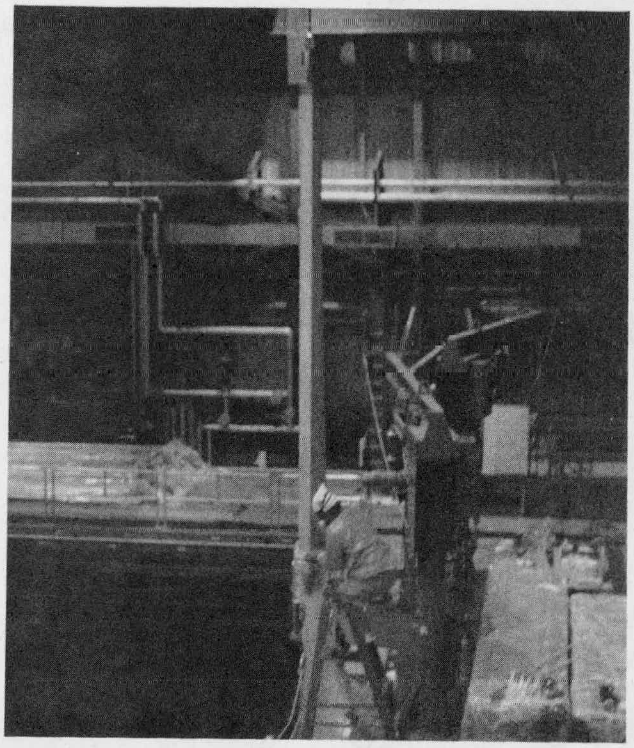


Figure 120. Putting Blade Guide into Plastic Bag (These Blade Guides are to be Modified by Changing the Upper Bracket from Aluminum to Stainless Steel) (Fitzpatrick)

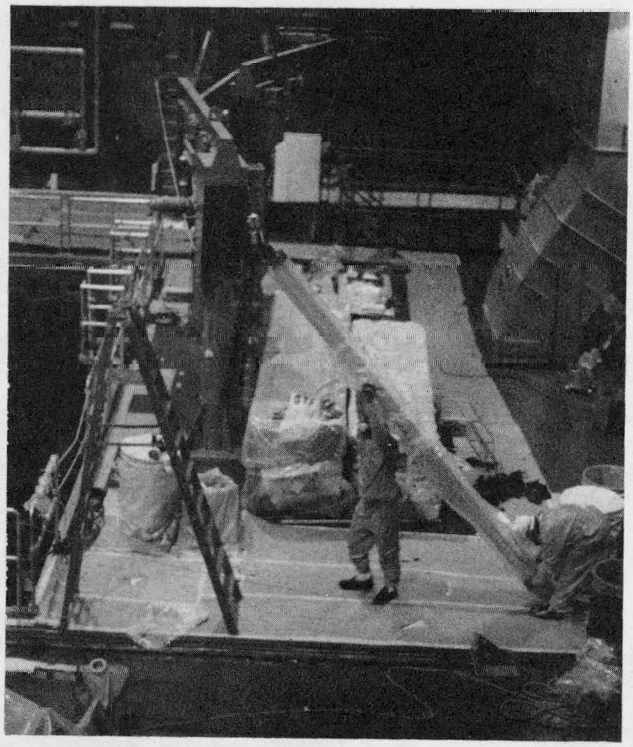


Figure 121. Bagging Blade Guide (Fitzpatrick)

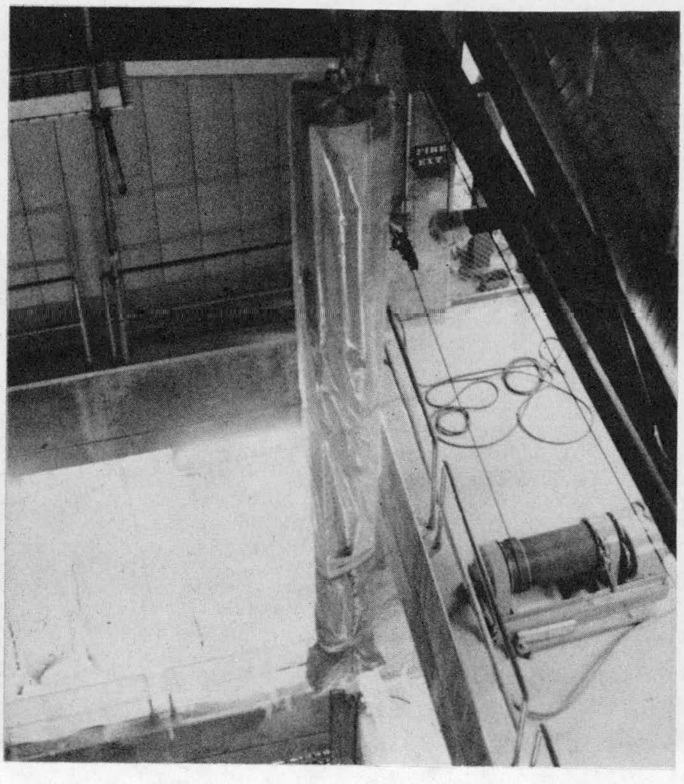


Figure 122. Lowering Blade Guide into Decon Room (Fitzpatrick)

Figure 123. Attaching Brackets to Blade Guides (Fitzpatrick)

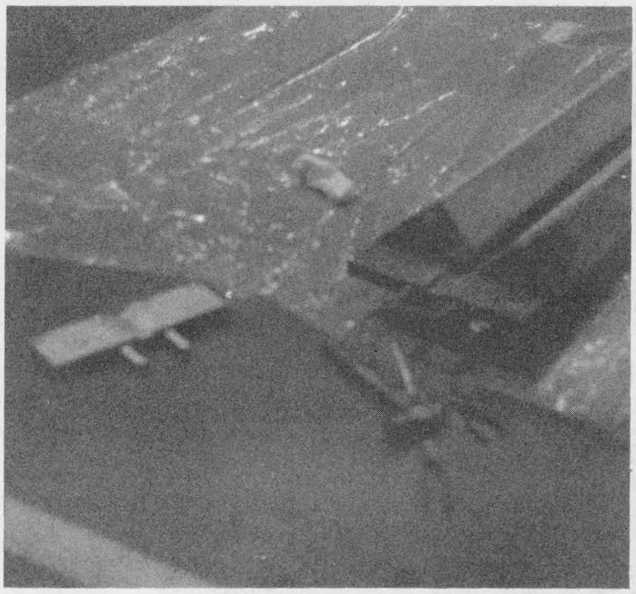


Figure 124. Aluminum Blade Guide Bracket Broke During Lift When Blade Guide Interferred with Storage Racks (See Figure 125)

Figure 125. Aluminum Blade Guide Bracket (Fitzpatrick)

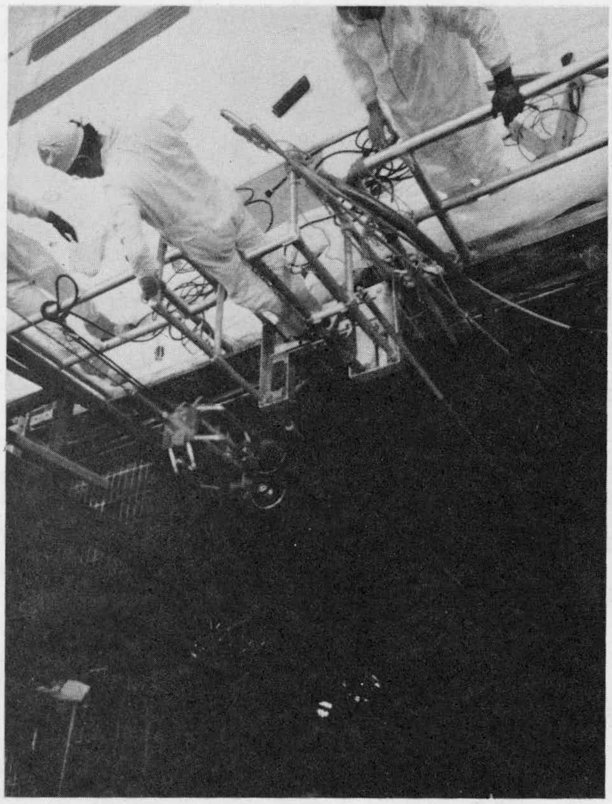


Figure 126. Equipment and Fixtures for Lower Tie Plate Drilling by EDM (Browns Ferry)

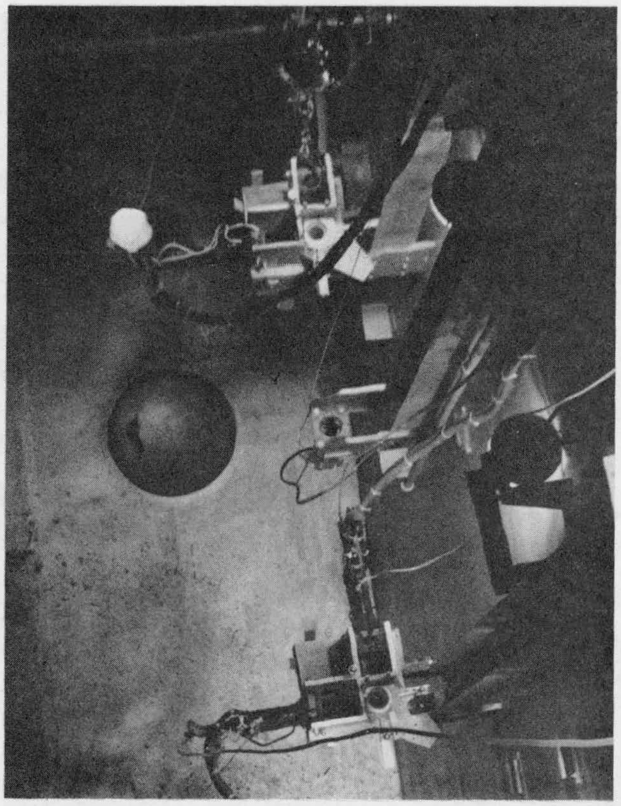


Figure 127. Equipment and Fixtures for Lower Tie Plate Drilling by EDM (Fitzpatrick)

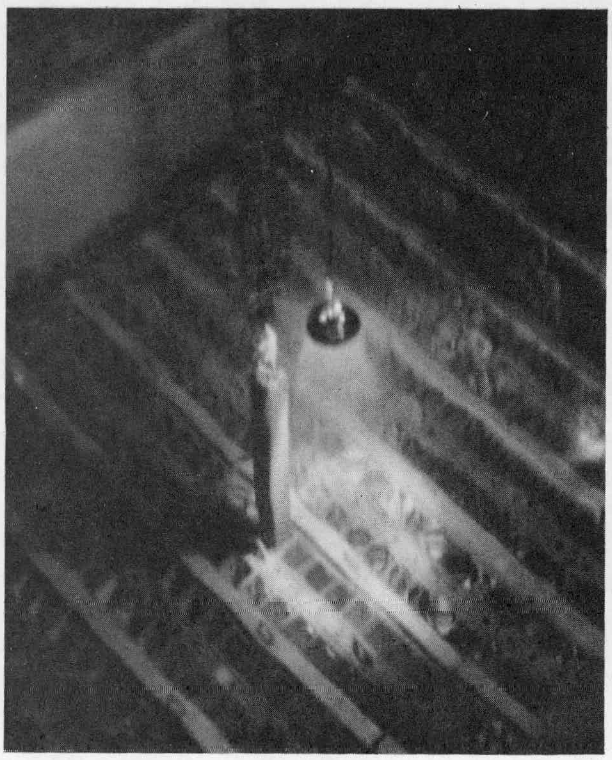


Figure 128. Equipment and Fixtures for Lower Tie Plate Drilling by EDM (Browns Ferry)

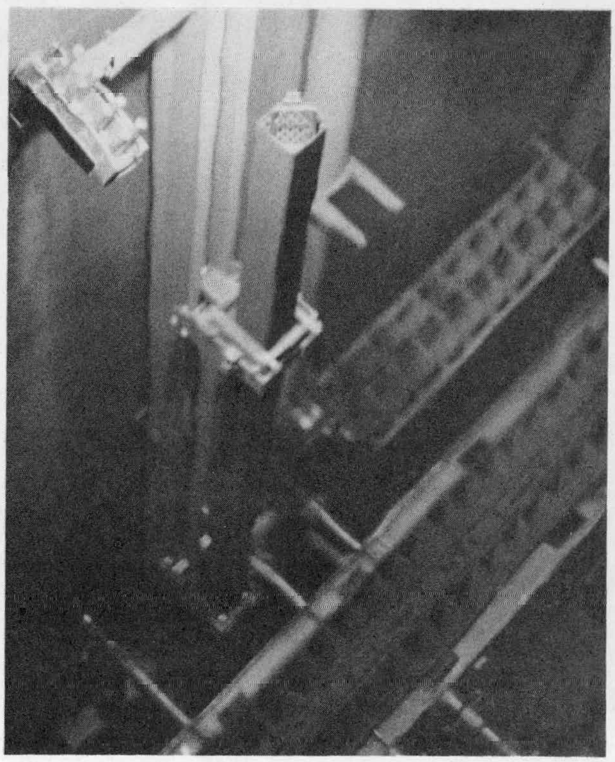
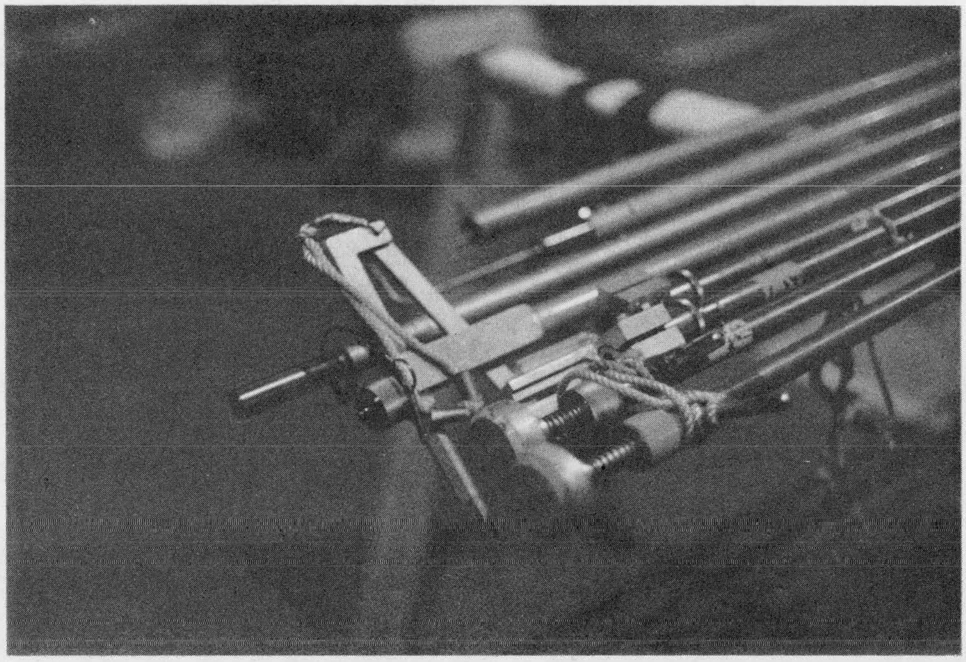


Figure 129. Equipment and Fixtures for Lower Tie Plate Drilling by EDM (Fitzpatrick)



130. Fuel Bundle Disassembly Tools (Fitzpatrick)

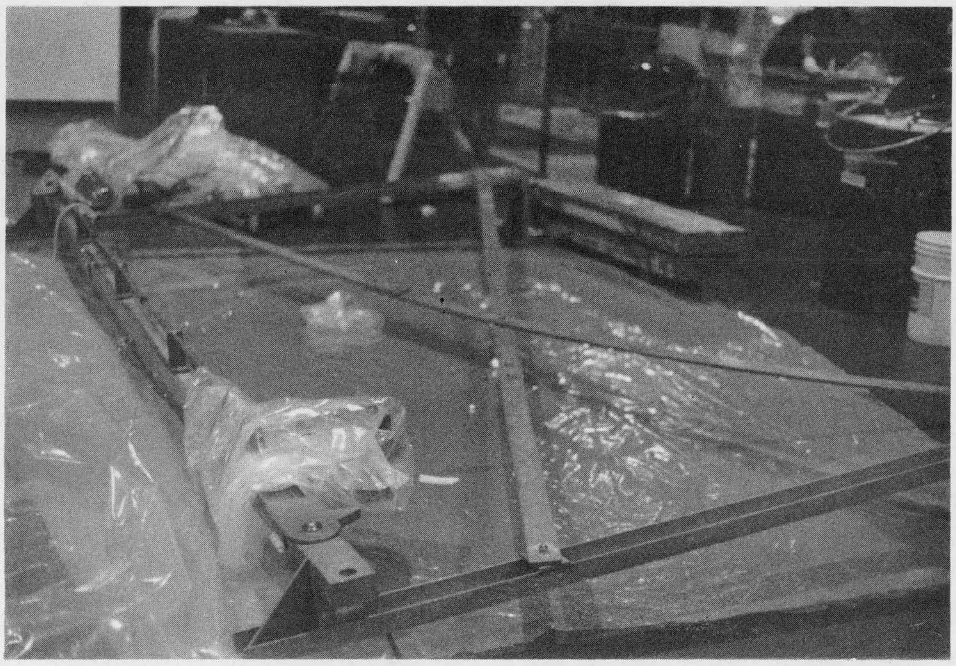


Figure 131. Channel Measurement Fixture (Fitzpatrick)

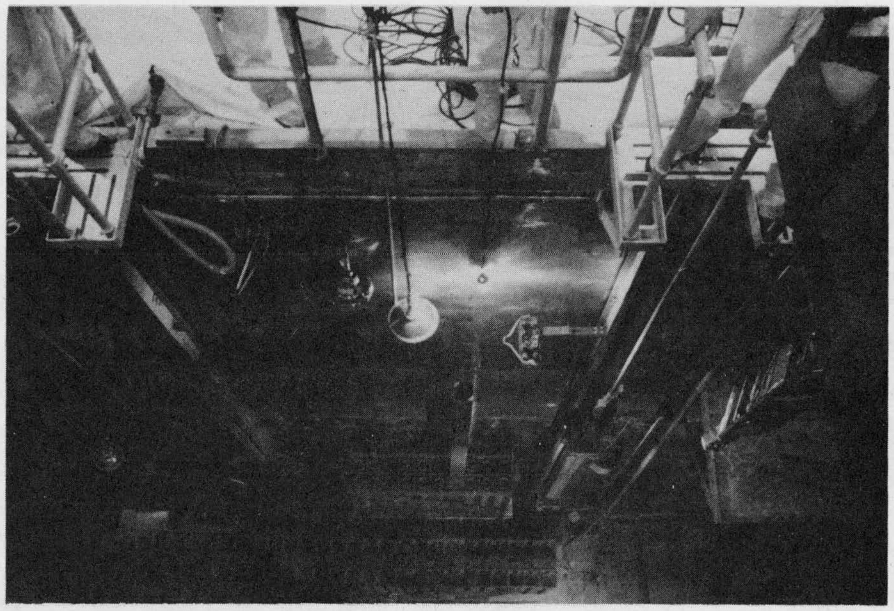


Figure 132. Channel Replacement - Fuel Prep Machine (Browns Ferry)

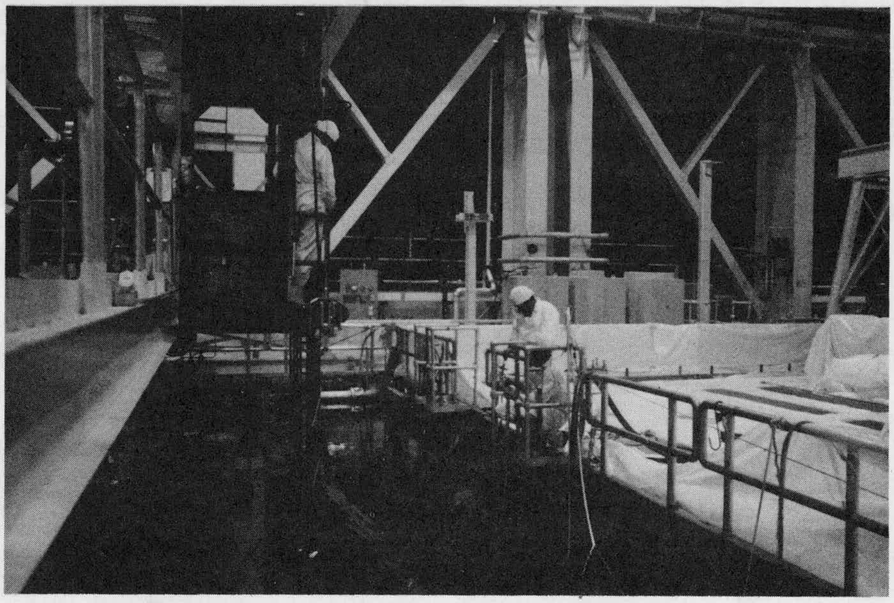


Figure 133. Lower Tie Plate Machining (Browns Ferry)

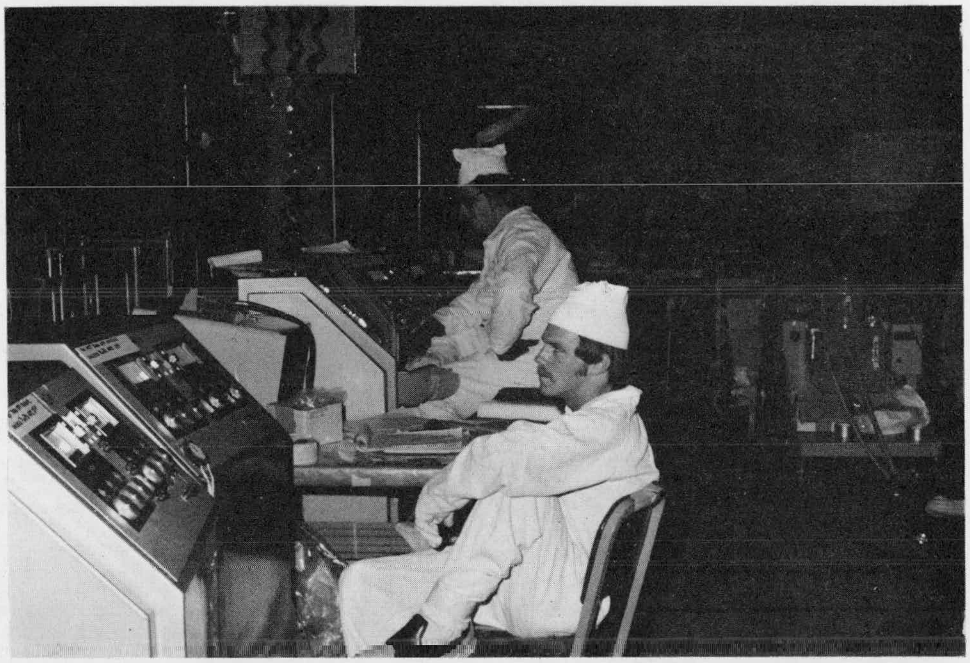


Figure 134. Lower Tie Plate Machining (Fitzpatrick)

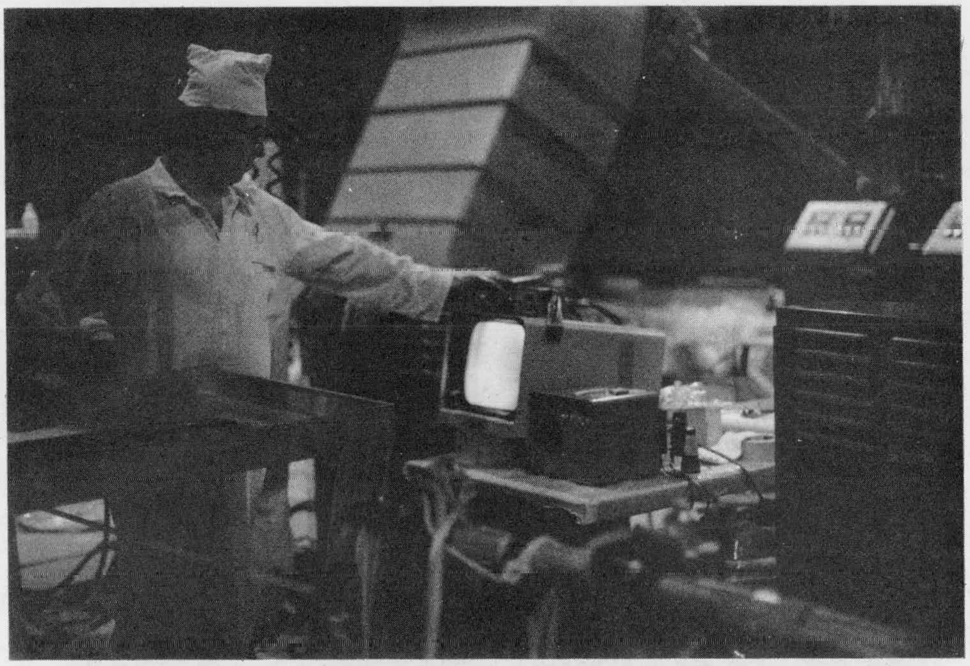


Figure 135. Underwater TV used to Assist in Vibration Instrumentation Removal (Fitzpatrick)

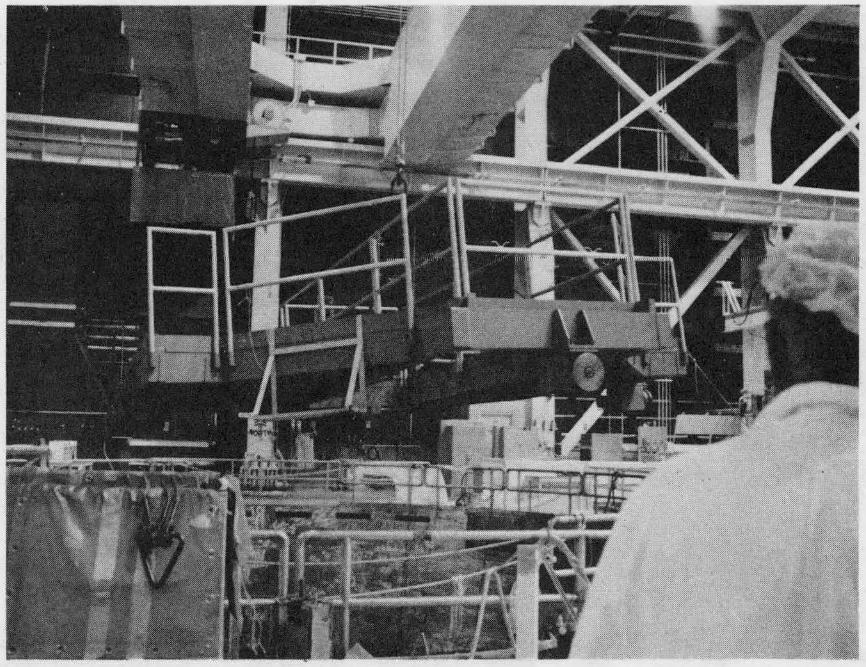


Figure 136. Lifting Service Platform (Browns Ferry)

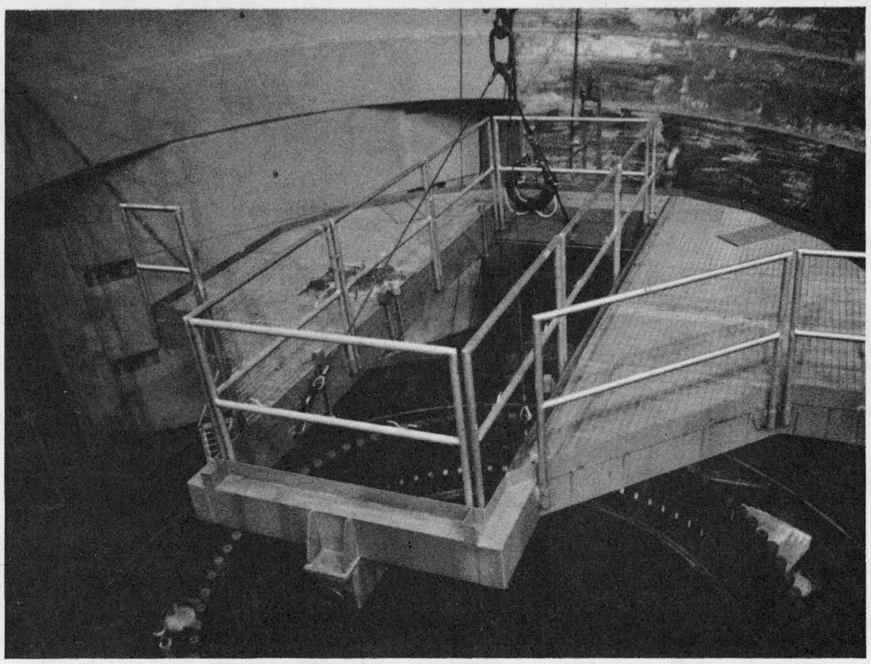


Figure 137. Lowering Service Platform onto the Reactor Vessel Track (Browns Ferry)

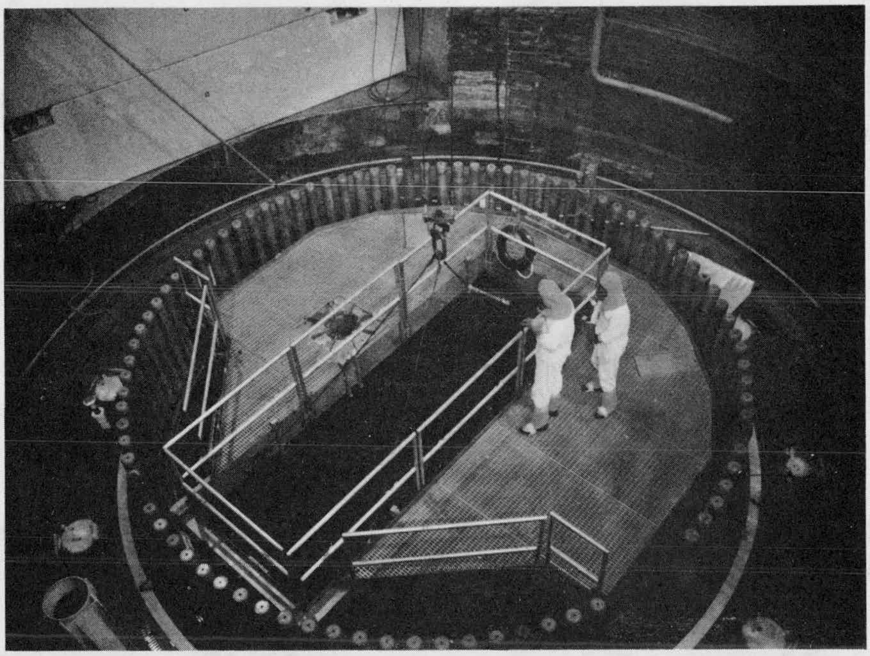


Figure 138. Service Platform in Position (Browns Ferry)

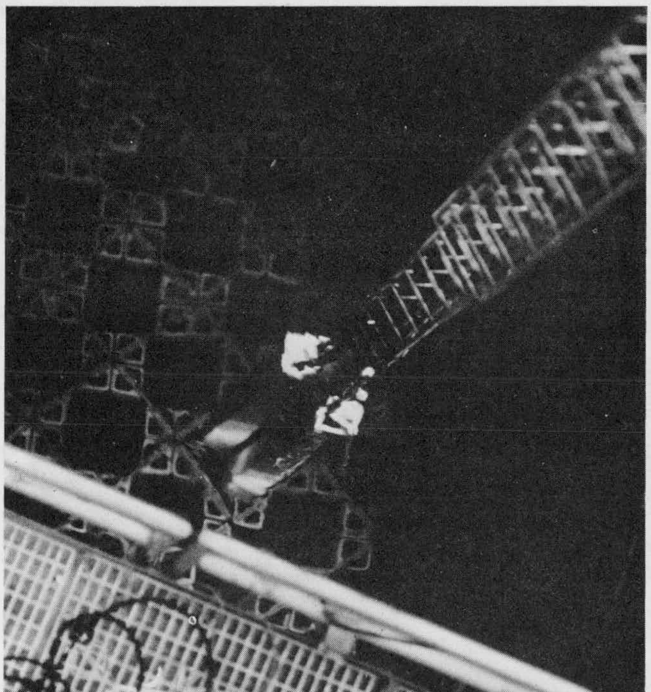


Figure 139. Removing Blade Guide (Browns Ferry)

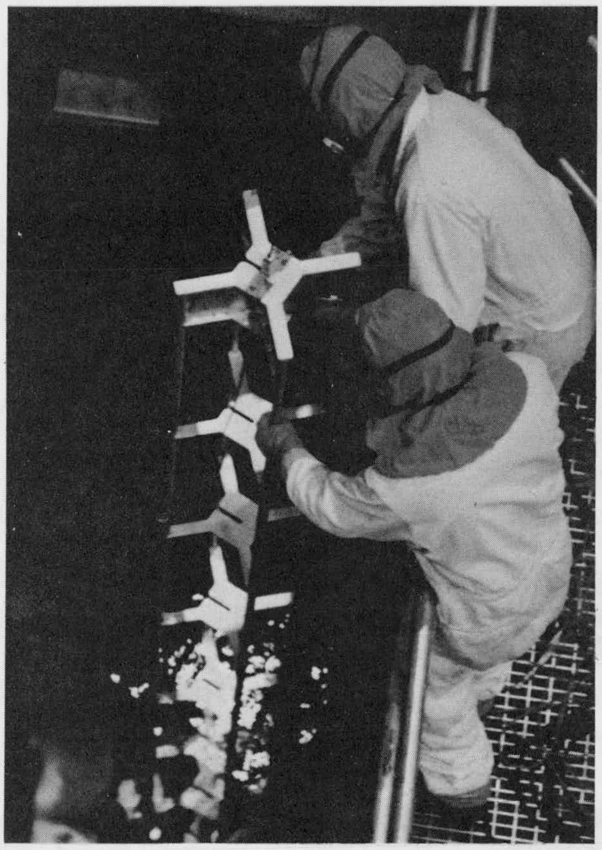


Figure 140. Grid Guide Tool (Browns Ferry)

Figure 141. Lowering Guide Tube Grapple (Browns Ferry)

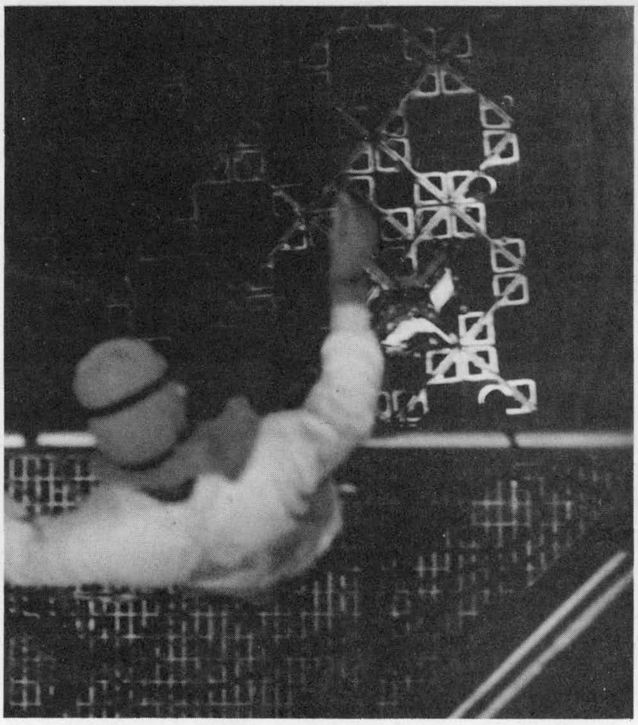


Figure 142. Removing Blade Guide (Browns Ferry)

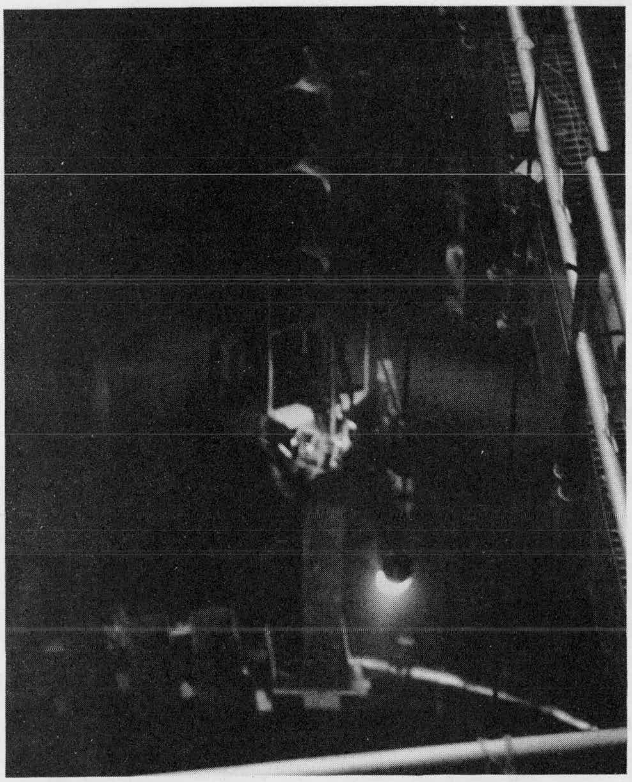


Figure 143. Pulling Control Rod Blade (Browns Ferry)

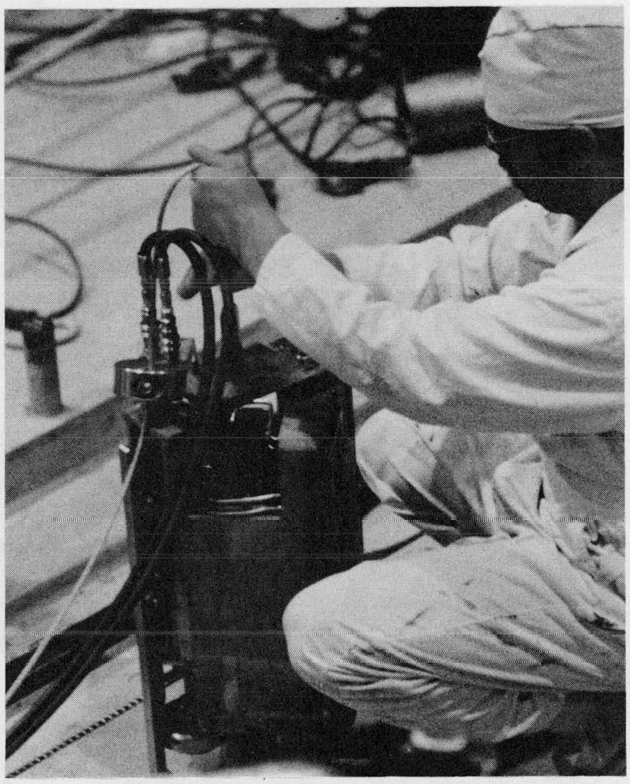


Figure 144. Making Ready the Fuel Support Grapple (Browns Ferry)

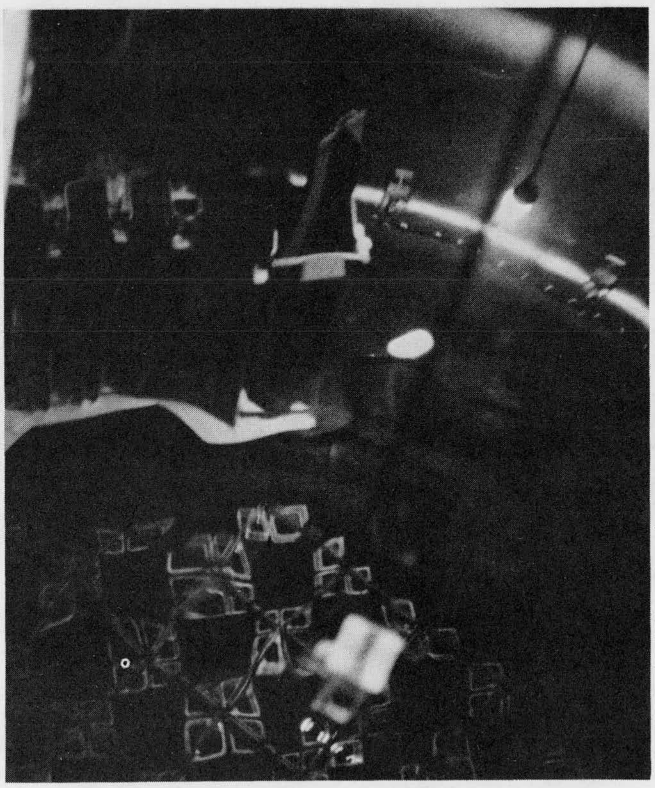


Figure 145. Pulling Guide Tube (Browns Ferry)

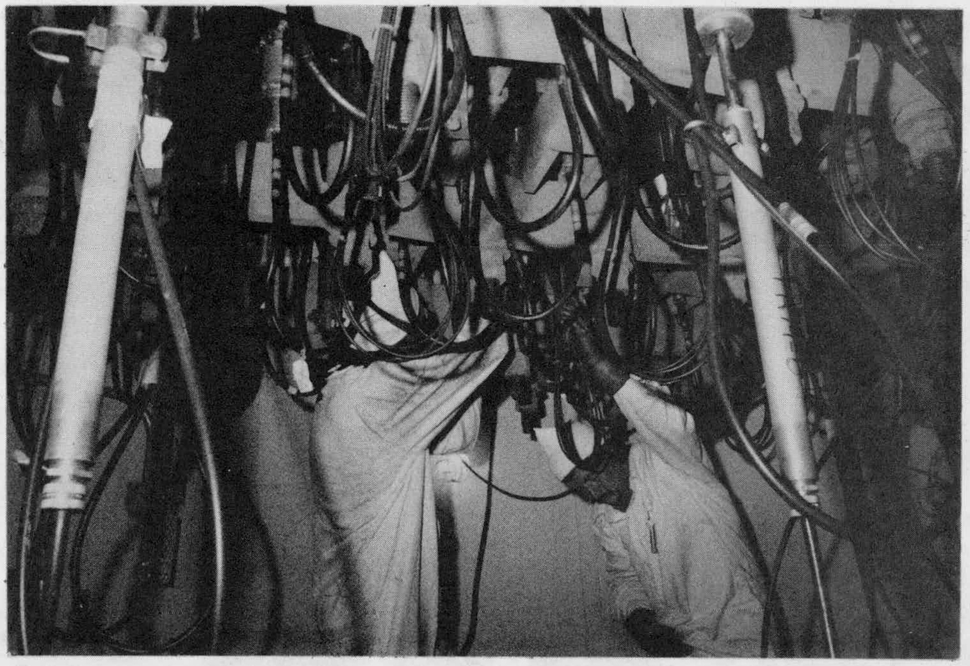


Figure 146. Undervessel LPRM Work (Fitzpatrick)

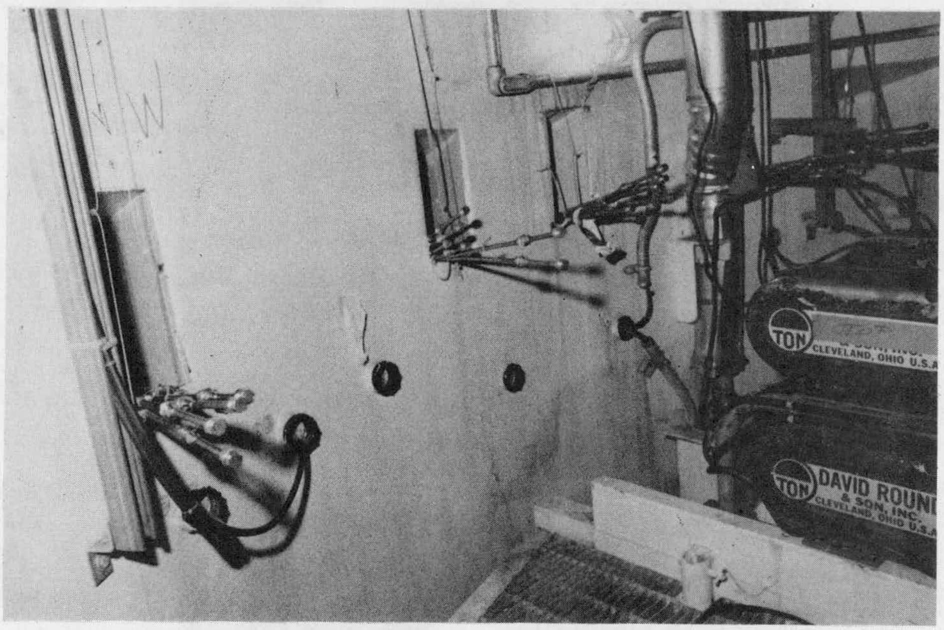


Figure 147. TIP Tubing Pedestal Penetration Undervessel - Also CRD Winch (Fitzpatrick)

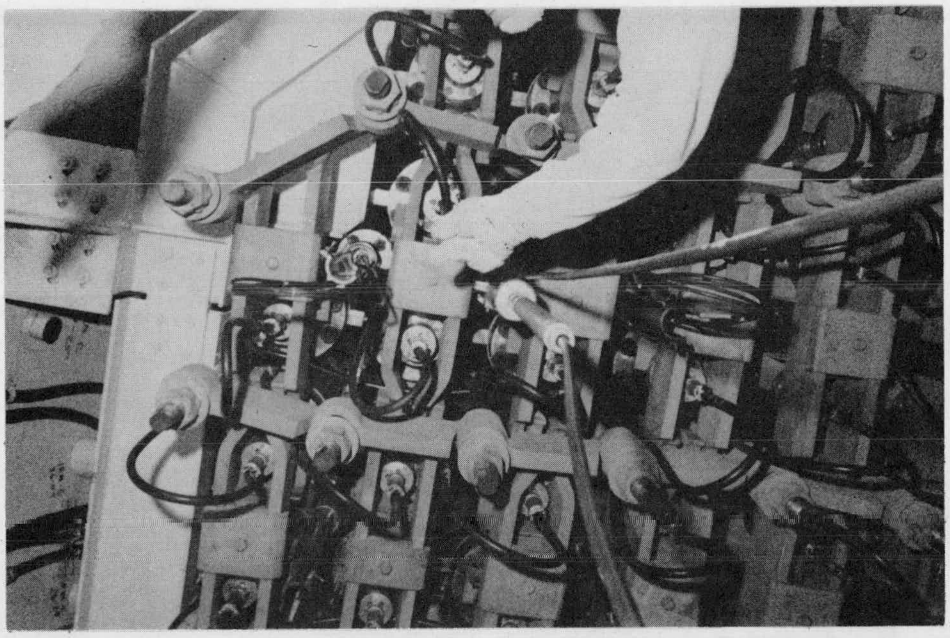


Figure 148. Undervessel Before LPRM Sleeves Installed (Fitzpatrick)

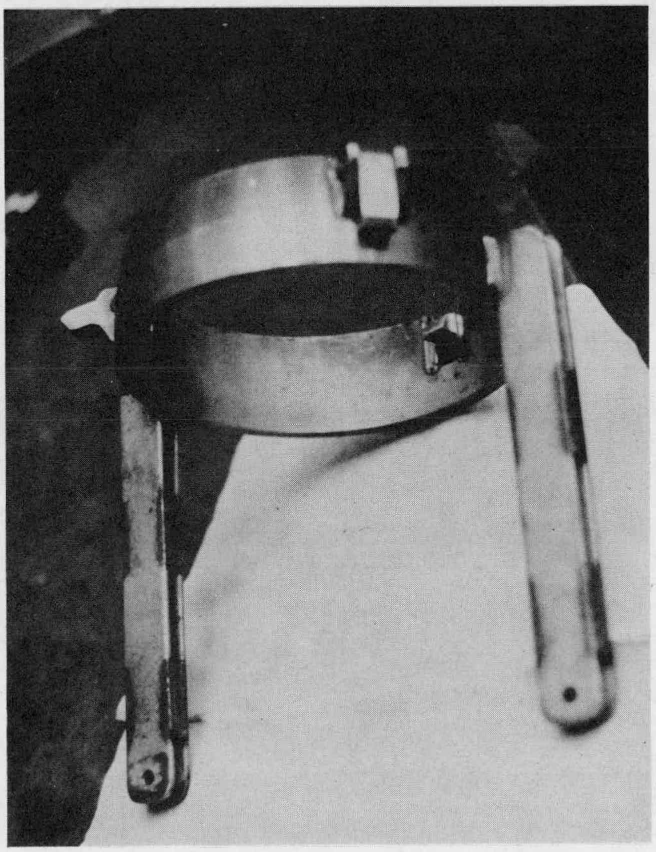


Figure 149. Control Rod Drive Housing Flange Attachment (Browns Ferry)

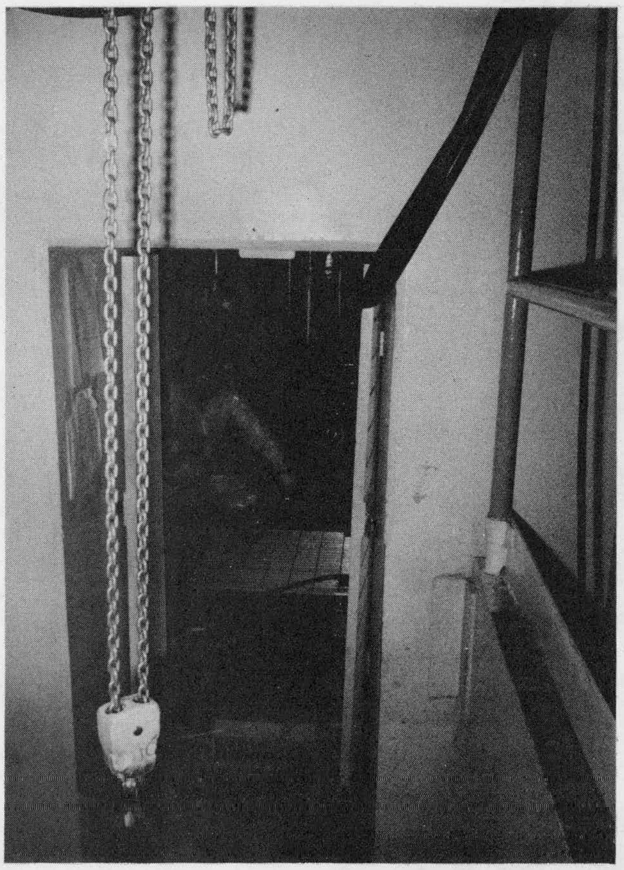


Figure 150. Transferring CRD to the CRD Cart

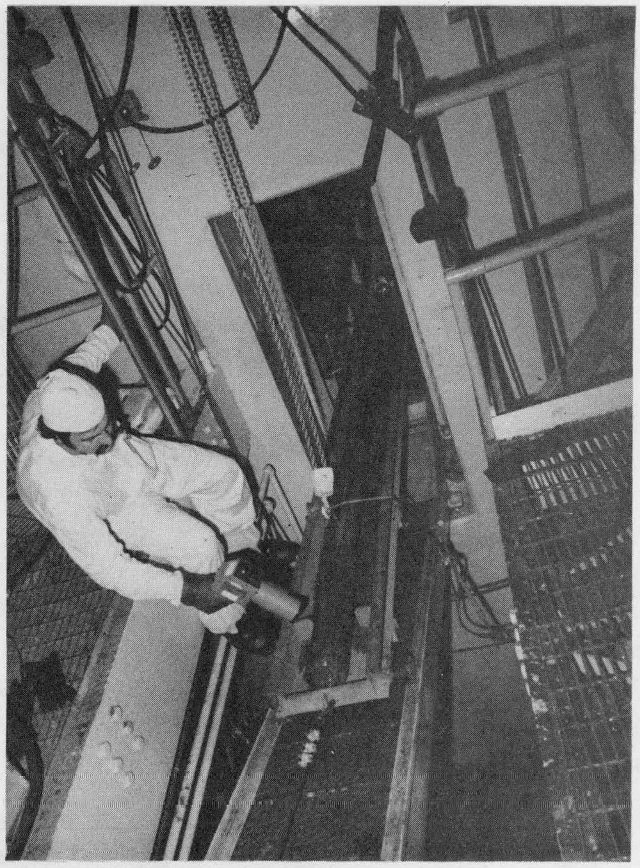


Figure 151. H. P. Surveying CRD Strainer - Lead Shield Pig is in Position

Figure 152. CRD Being Removed Freeing Binding Cable

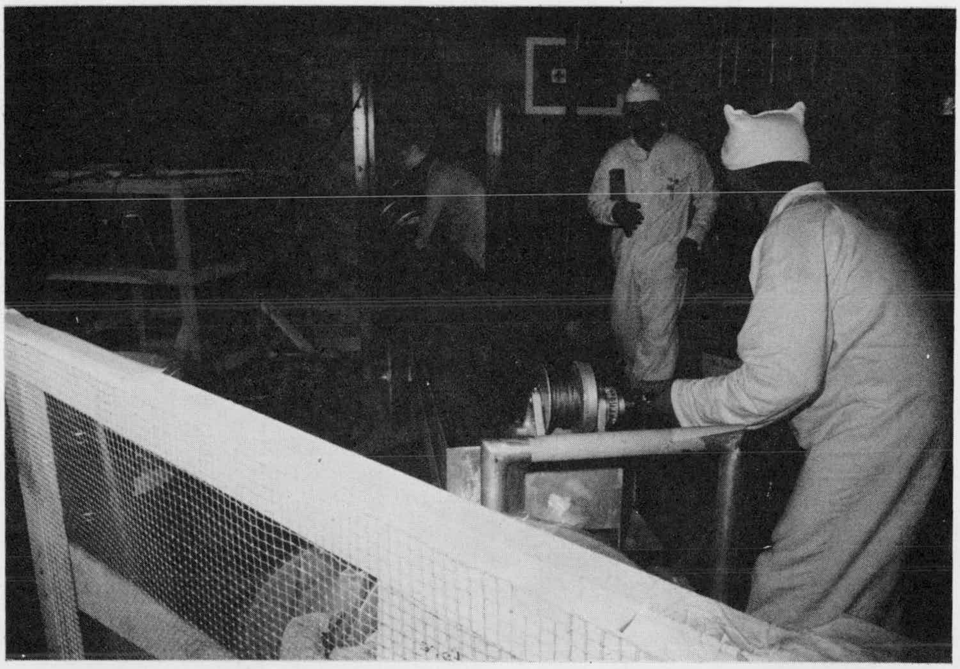


Figure 153. Removing CRD From Drywell - Note Poor Lighting

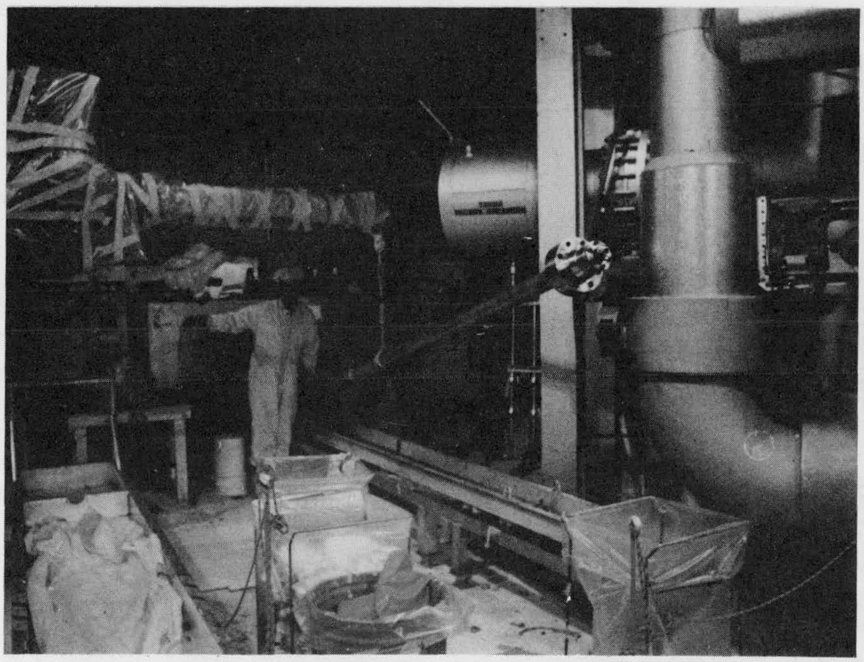


Figure 154. Lifting CRD Out of CRD Cart (Browns Ferry)

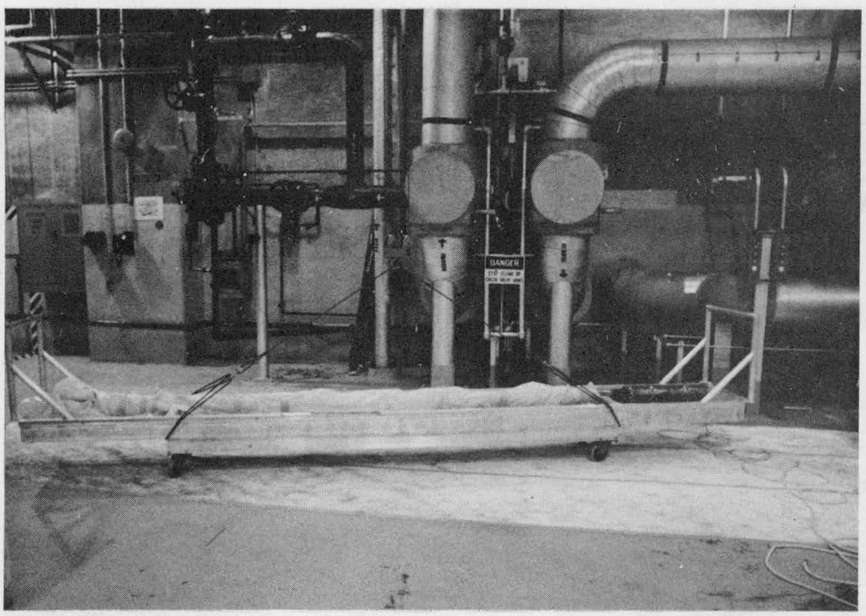


Figure 155. CRD in Cradle and Ready for Lift (Browns Ferry)

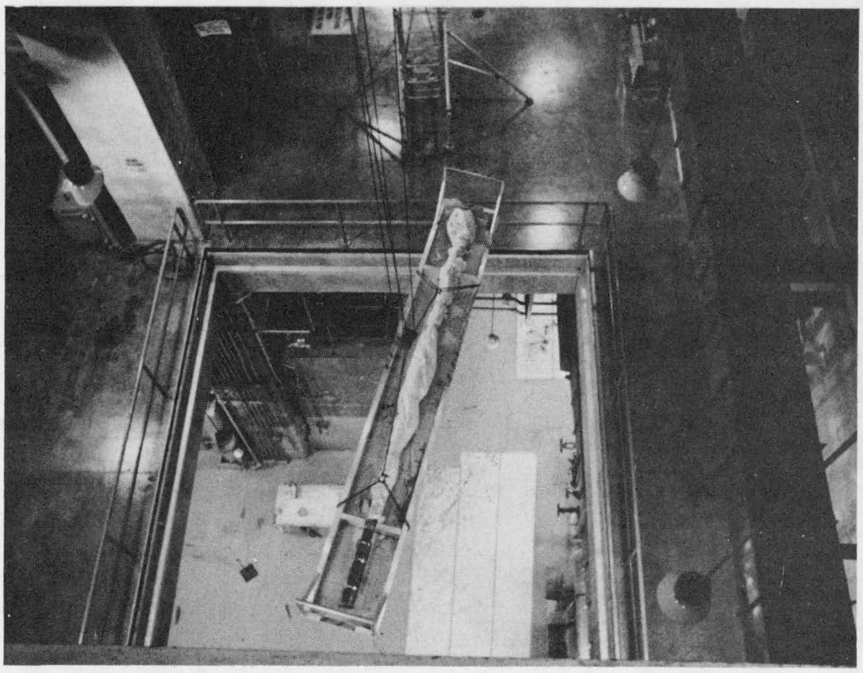


Figure 156. CRD in Cradle and Enroute to Overhaul Room (Browns Ferry)

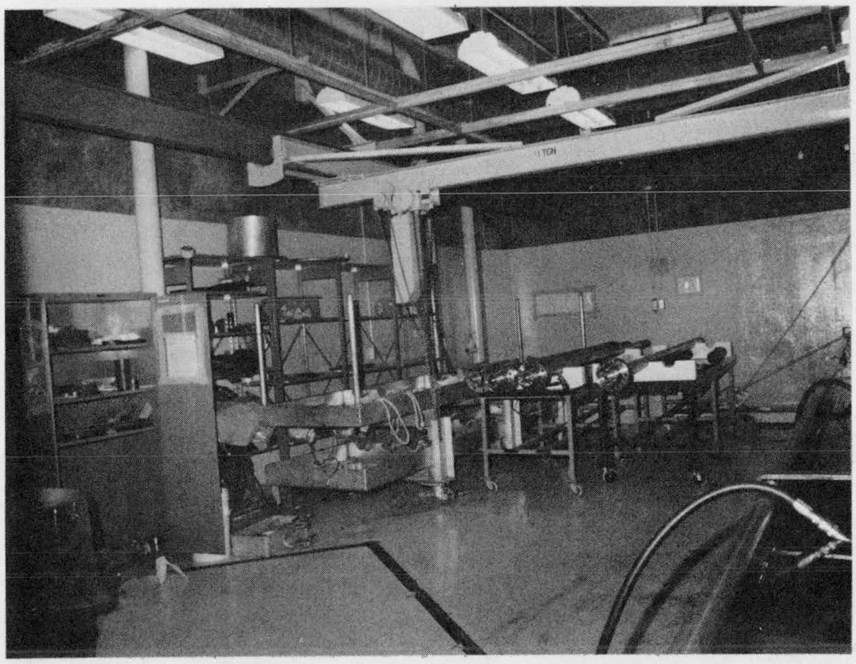


Figure 157. Control Rod Drive Overhaul Room

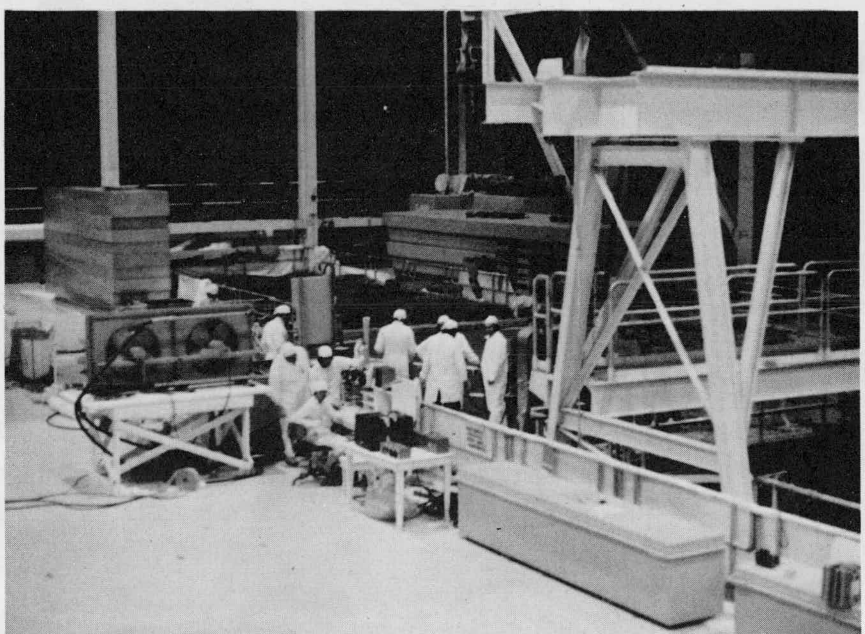


Figure 158. Refueling Floor Clad Removal Equipment

Figure 159. Reactor Pressure Vessel Temporary Shielding

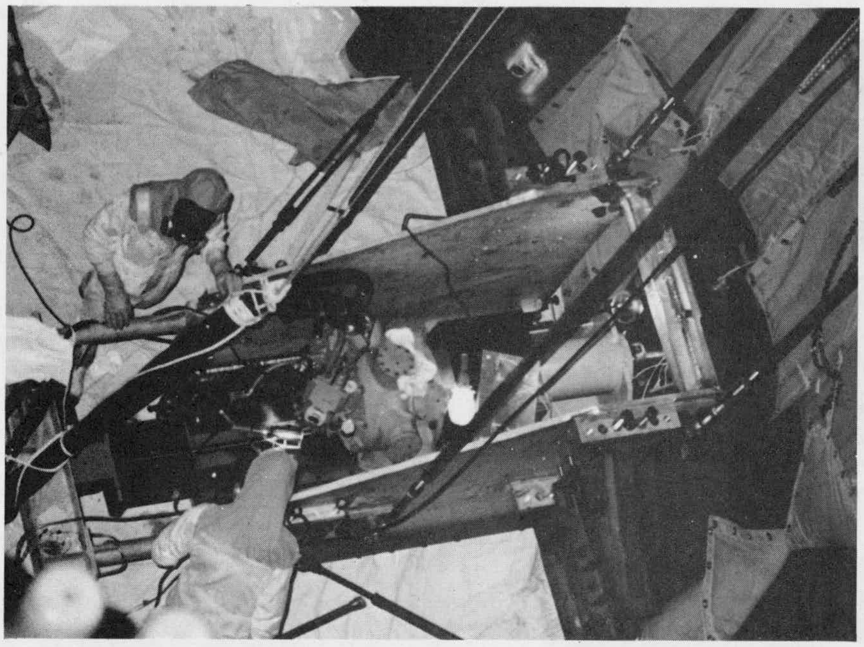


Figure 160. Feedwater Nozzle Clad Removal Machine

Figure 161. LPRM Handling Tool

Figure 162. View through Cattle Chute

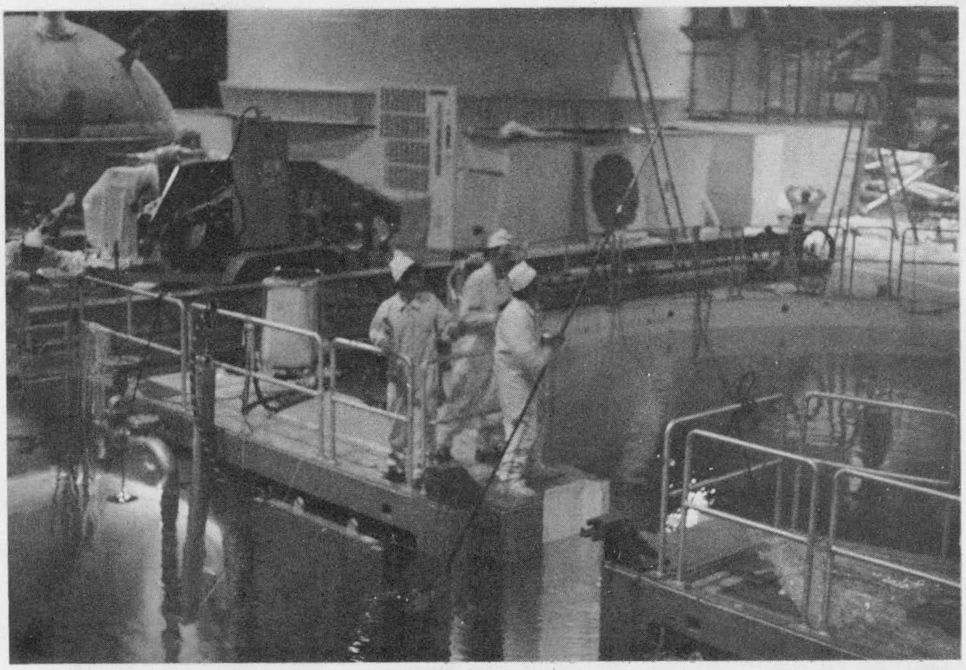


Figure 163. Lifting an LPRM to Check Bullet Nose

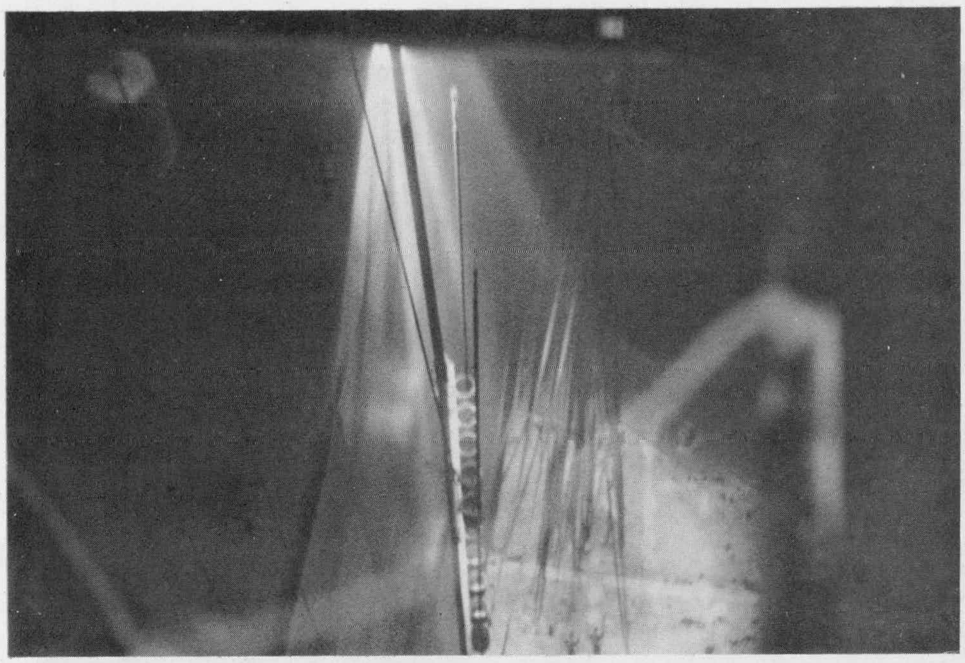


Figure 164. Spent LPRM in Fuel Pool (Fitzpatrick)

Figure 165. LPRM Strongback - Holds only One (1) LPRM (Fitzpatrick)

Figure 166. New LPRM has been Removed from Strongback - Will now be Placed in LPRM Holding Tool (Fitzpatrick)

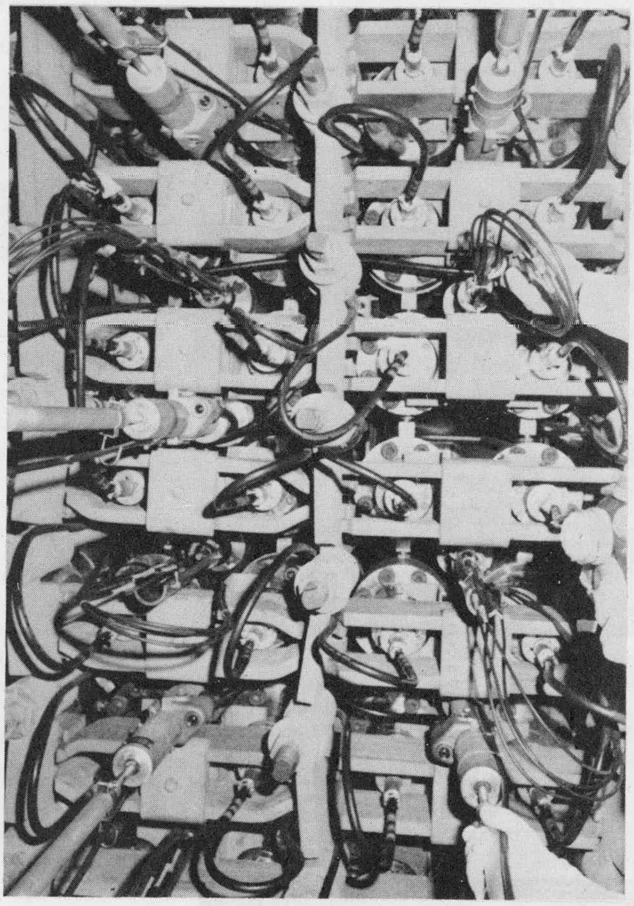


Figure 167. Undervessel after LPRM Replacement (Fitzpatrick)

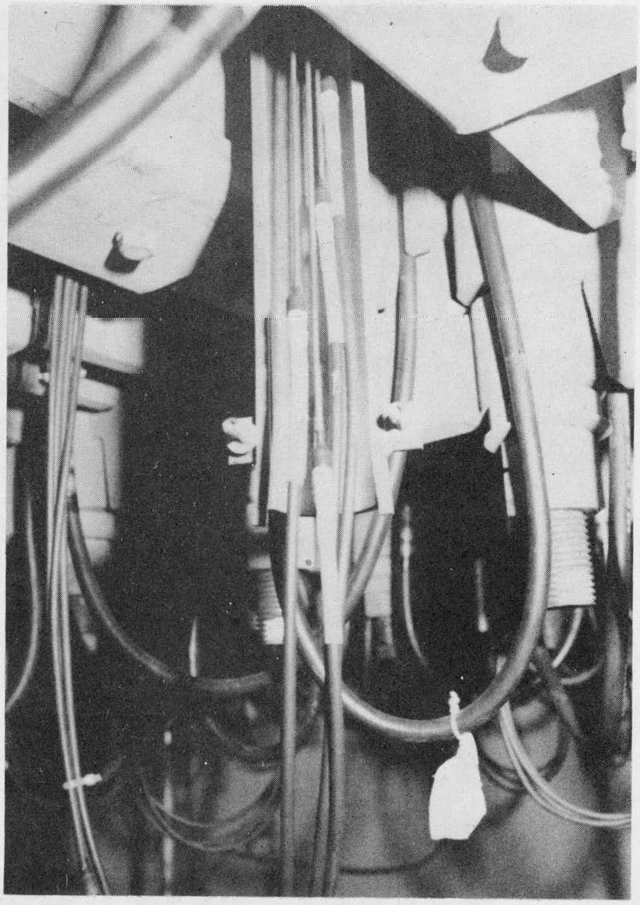


Figure 168. LPRM Connection under Vessel Before Installation of Sleeve Cover (Fitzpatrick)

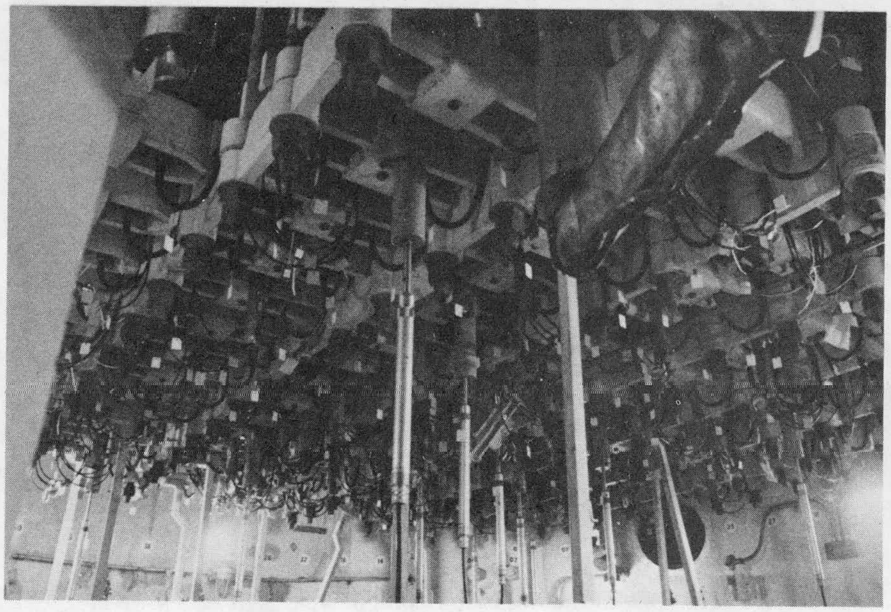


Figure 169. Undervessel showing SRM's and IRM's (Browns Ferry)

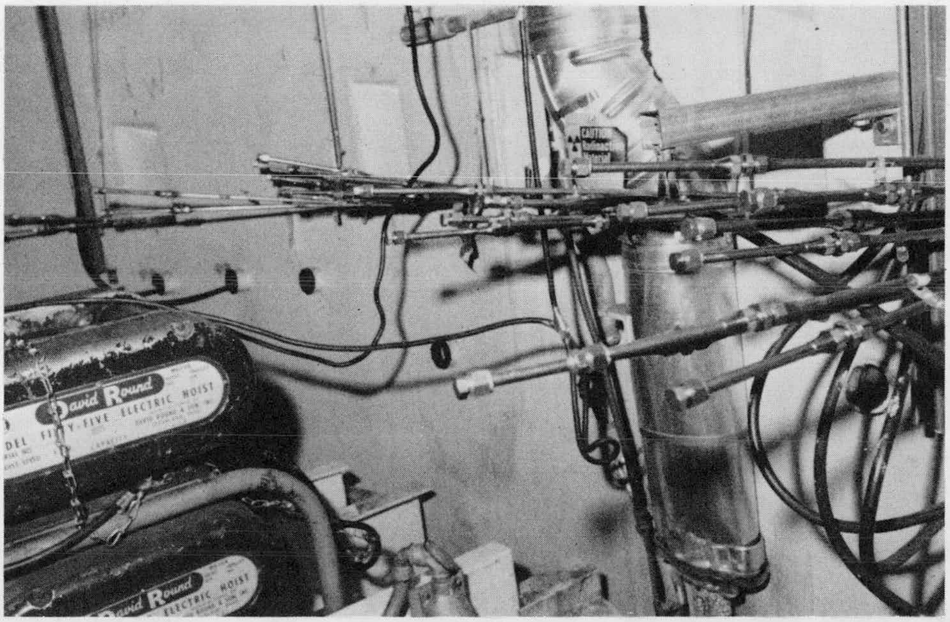


Figure 170. TIP Tubing and Pedestal Penetration - Note RPV Drain Line (Fitzpatrick)

Figure 171. (Removed)

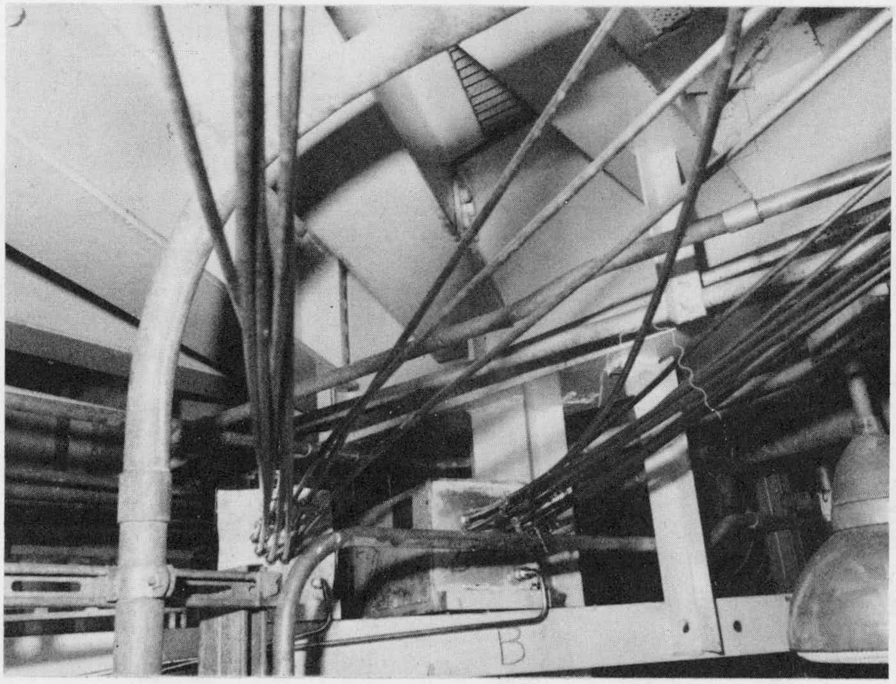


Figure 172. TIP Tubing and Indexing Mechanism After Rework (Fitzpatrick)

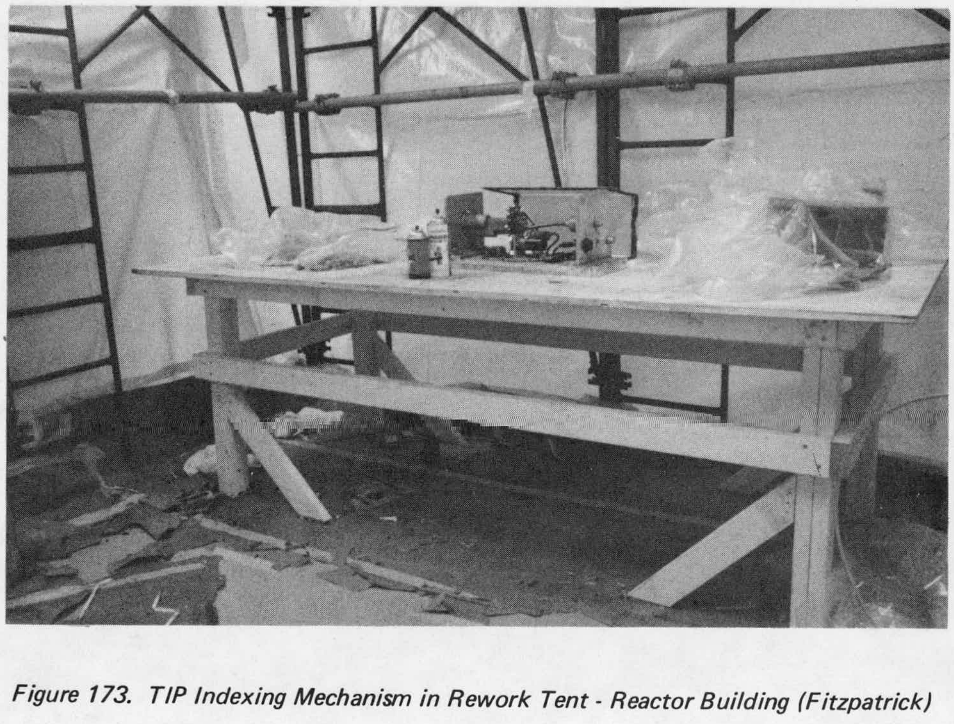


Figure 173. TIP Indexing Mechanism in Rework Tent - Reactor Building (Fitzpatrick)

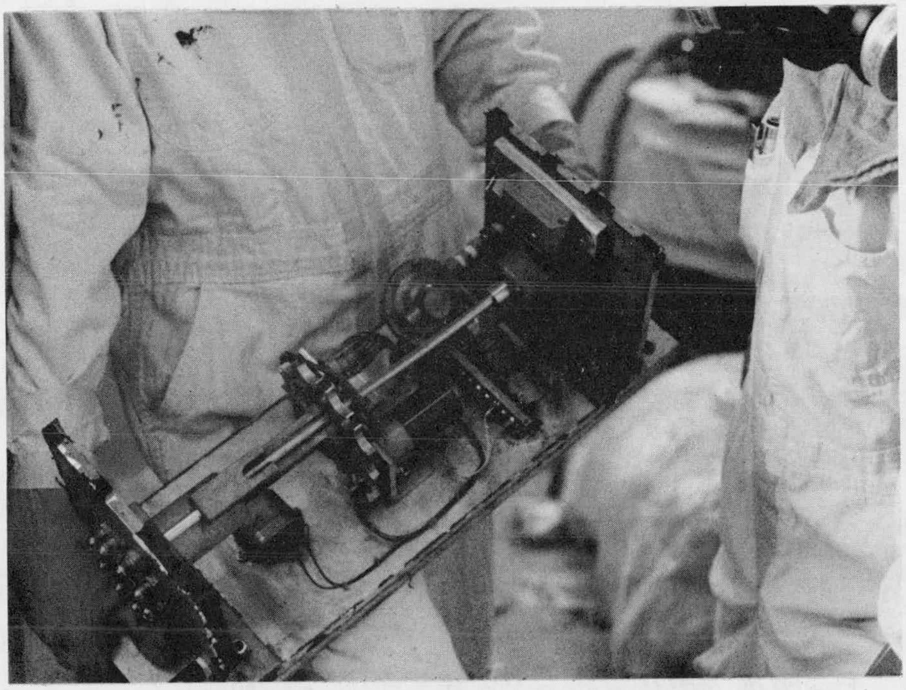


Figure 174. TIP Indexing Mechanism (Browns Ferry)

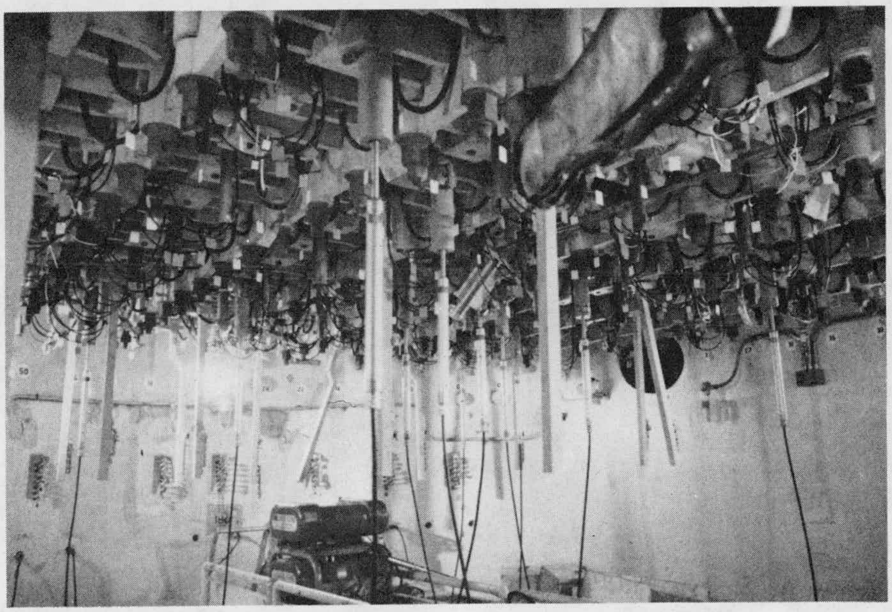


Figure 175. Under Vessel (Browns Ferry)

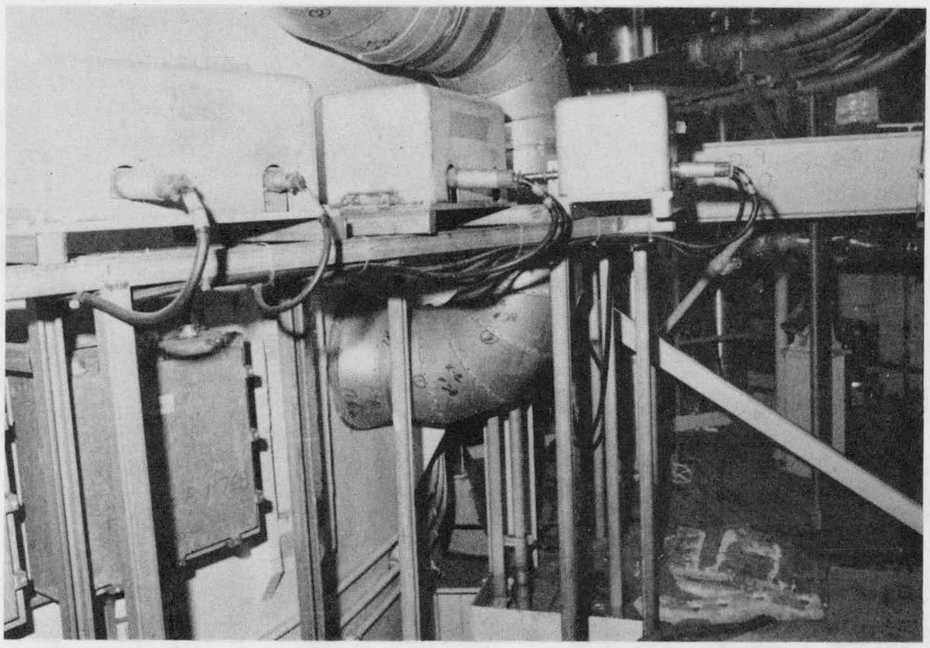


Figure 176. SRM Drive Motor Modules - Drywell (Fitzpatrick)

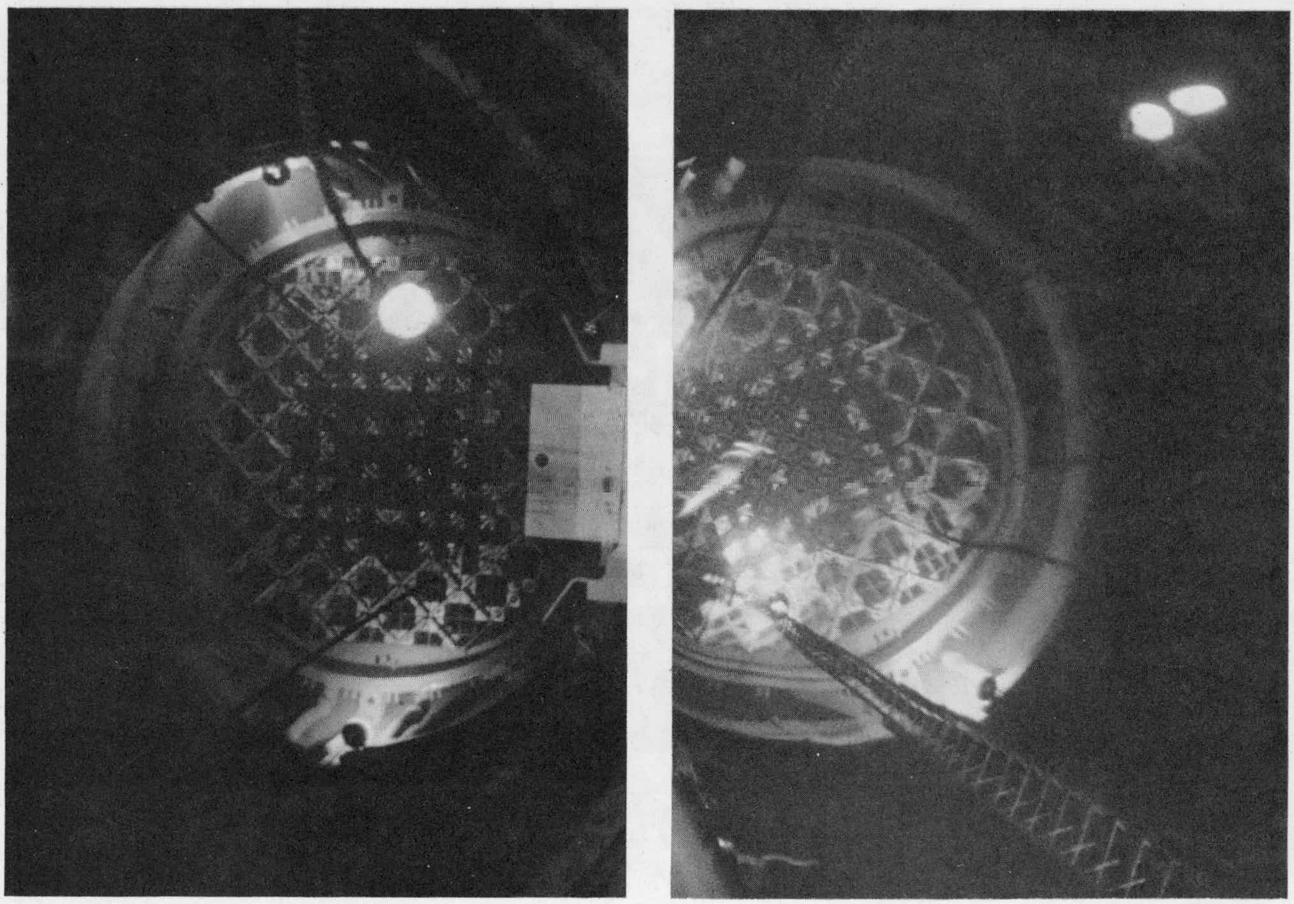


Figure 177. (Right) Dunking Chamber Installation (Fitzpatrick) - (Left) Fuel Loading in Core (Fitzpatrick)

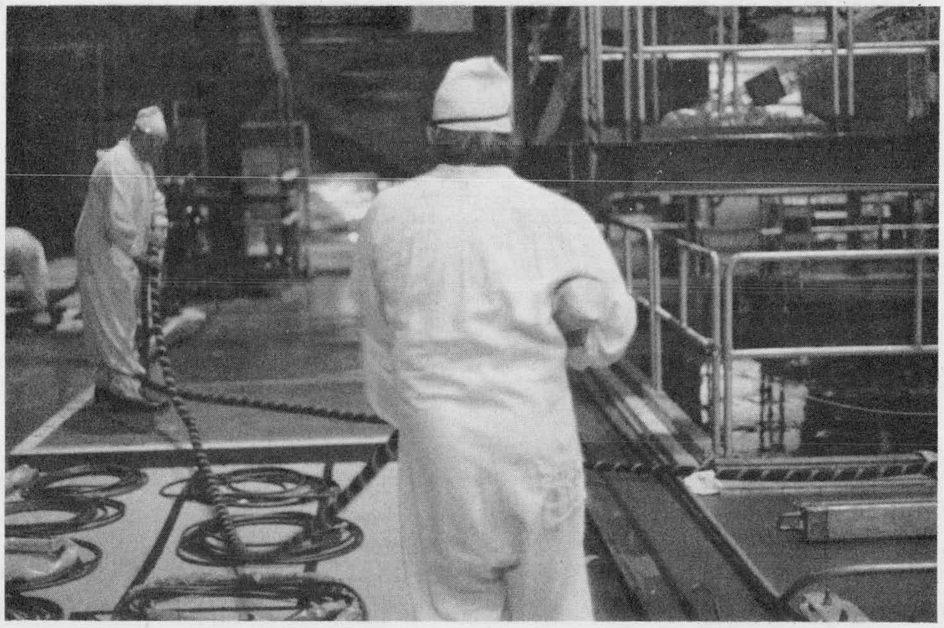


Figure 178. Dunking Chamber Hose (Fitzpatrick)

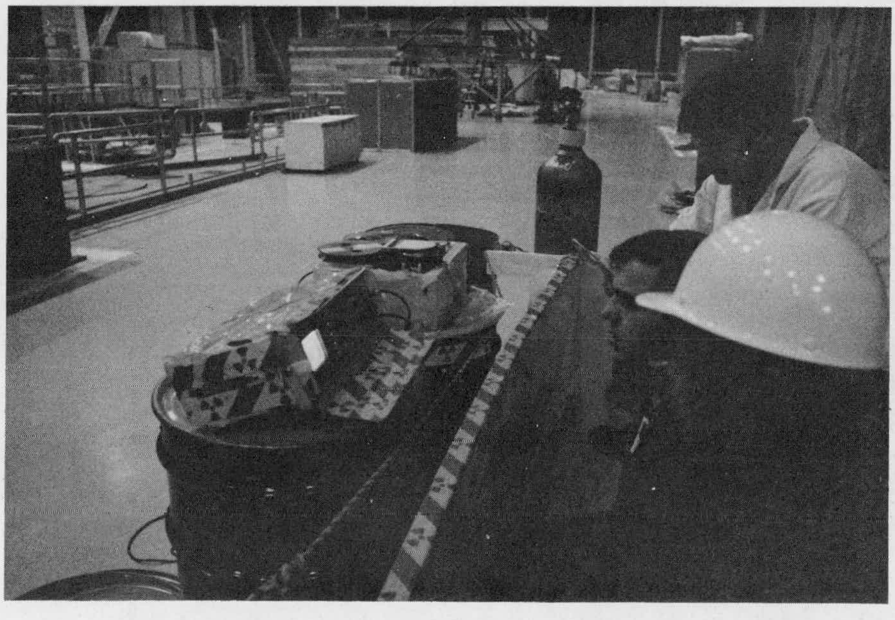


Figure 179. Verifying Core Loading - Looking at Video Tape of Core Load (Browns Ferry)

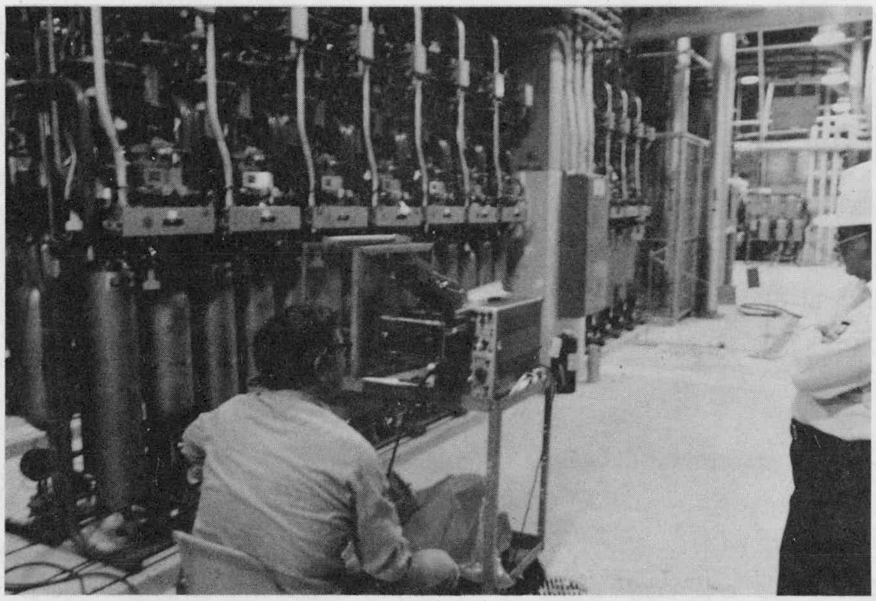


Figure 180. Friction Test of CRD's - Oscilloscope and Camera (Browns Ferry)

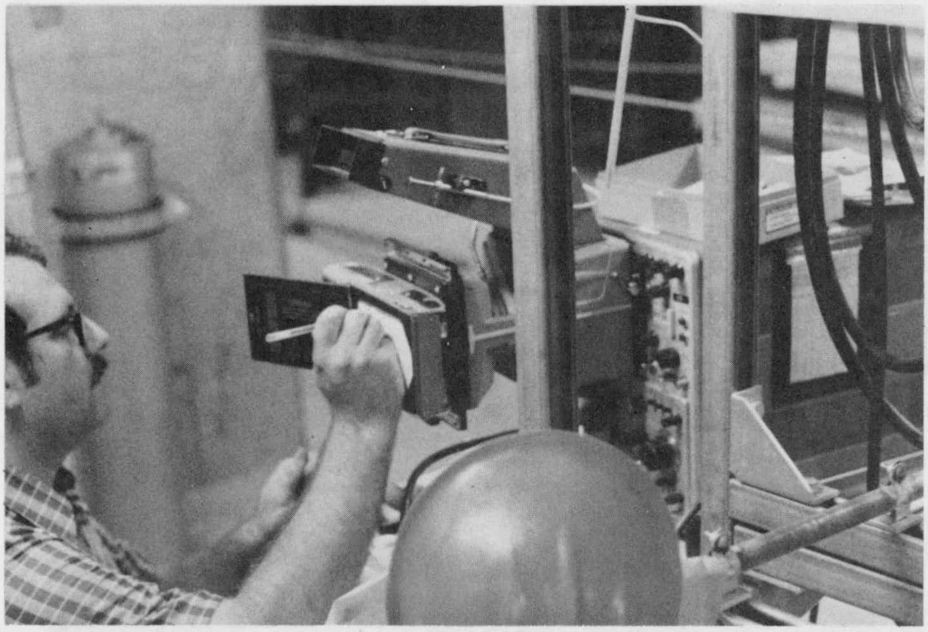


Figure 181. CRD Drop Timing (Fitzpatrick)

Figure 182. Underwater Light Before Use (Fitzpatrick)

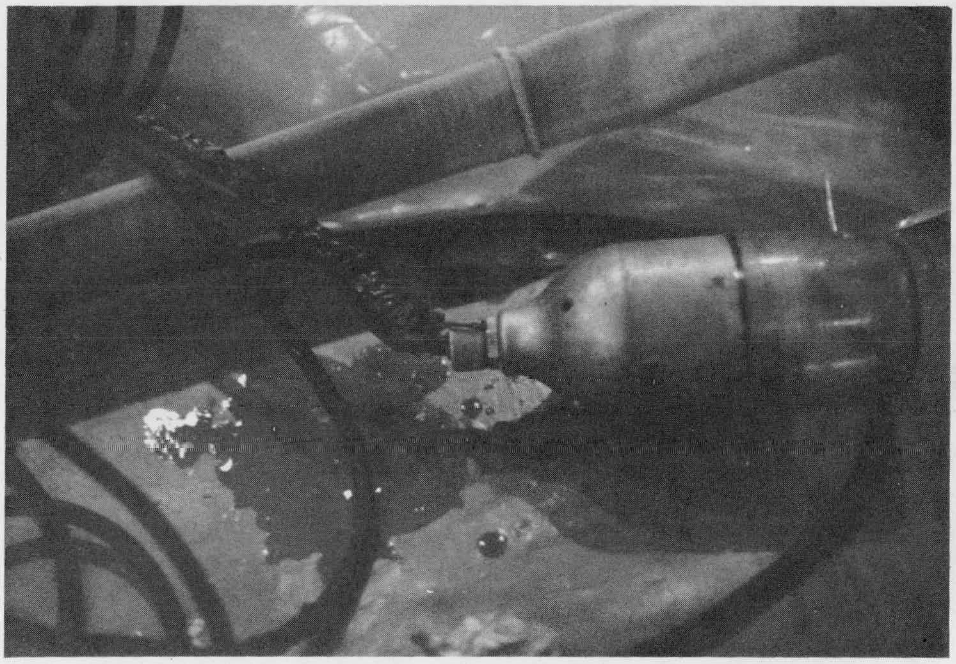


Figure 183. Underwater Light Failure (Fitzpatrick)

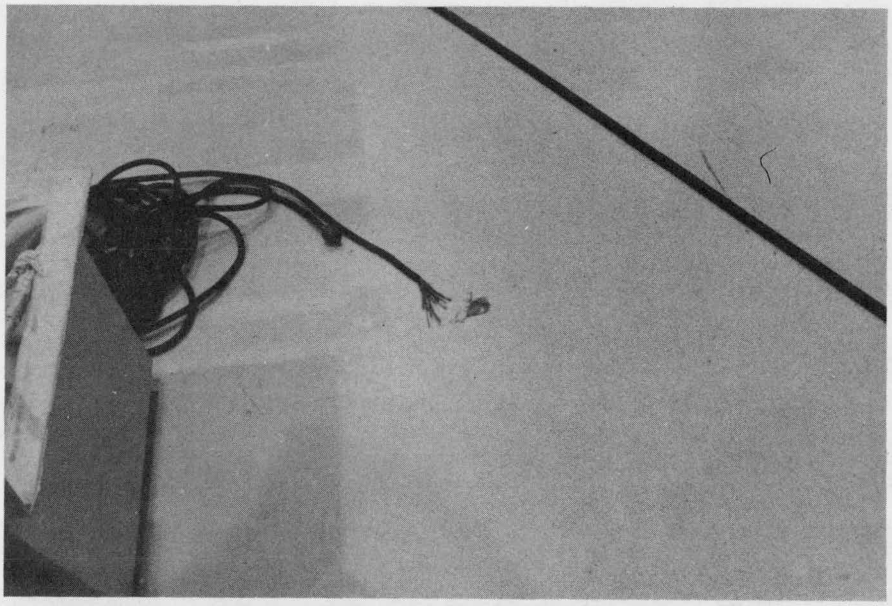


Figure 184. Broken Underwater Light Cord Caused by Light Becoming Trapped Under Separator (Browns Ferry)

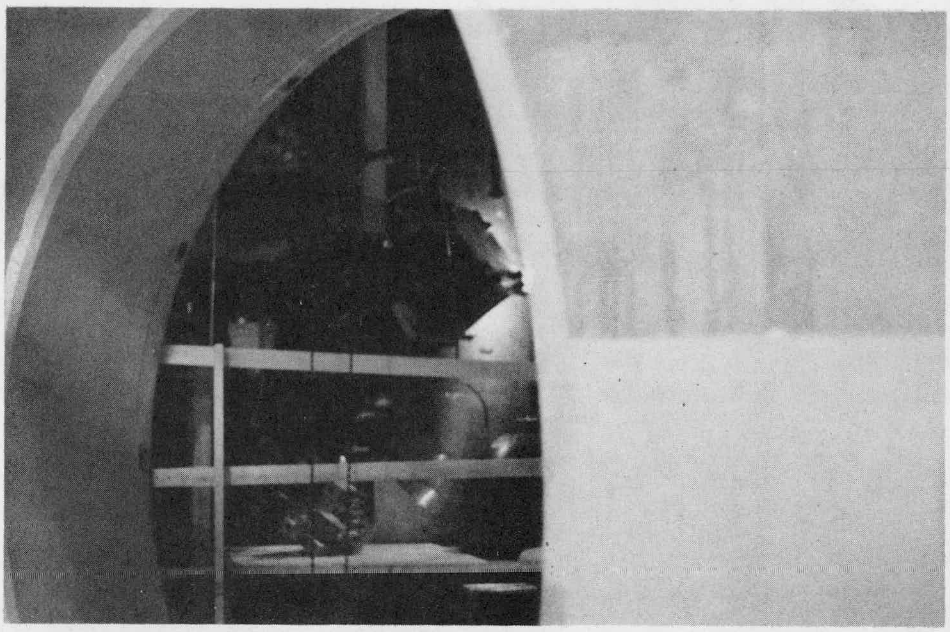


Figure 185. Inboard MSIV - Looking Through Equipment Hatch into Drywell (Browns Ferry)

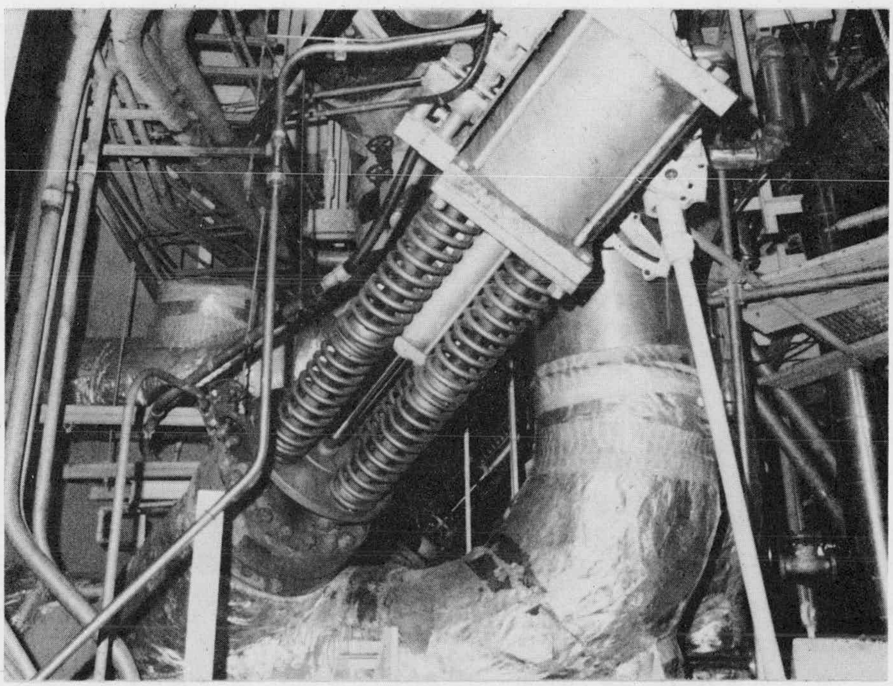


Figure 186. "D" Inboard MSIV (Fitzpatrick)

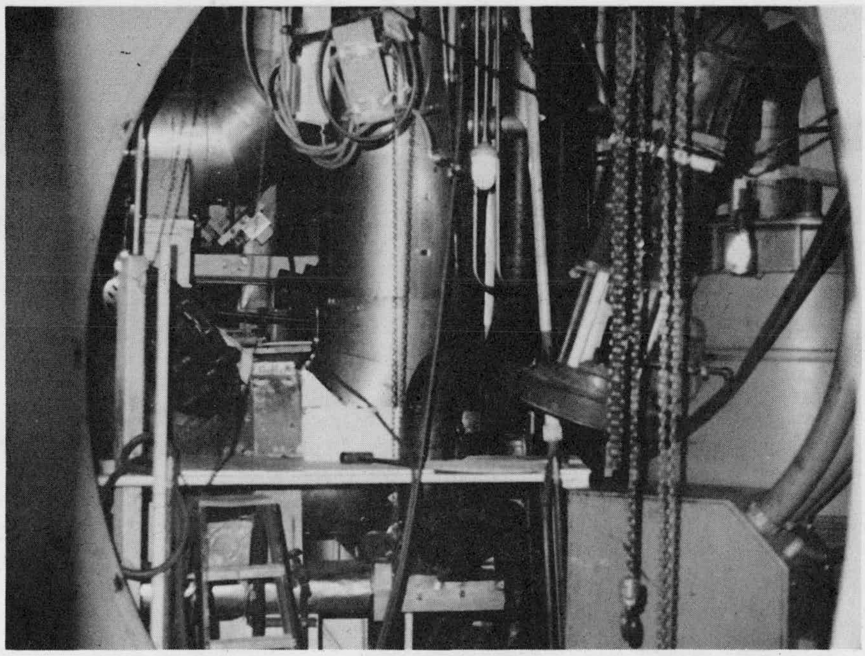


Figure 187. MSIV Operator Hanging at Right - Note MSIV Test Plug in Position - Inboard Valve (Browns Ferry)

Figure 188. MSIV Poppet - Atwood Morrill (Browns Ferry)

Figure 189. MSIV Internals Being Removed - Rockwell (Fitzpatrick)

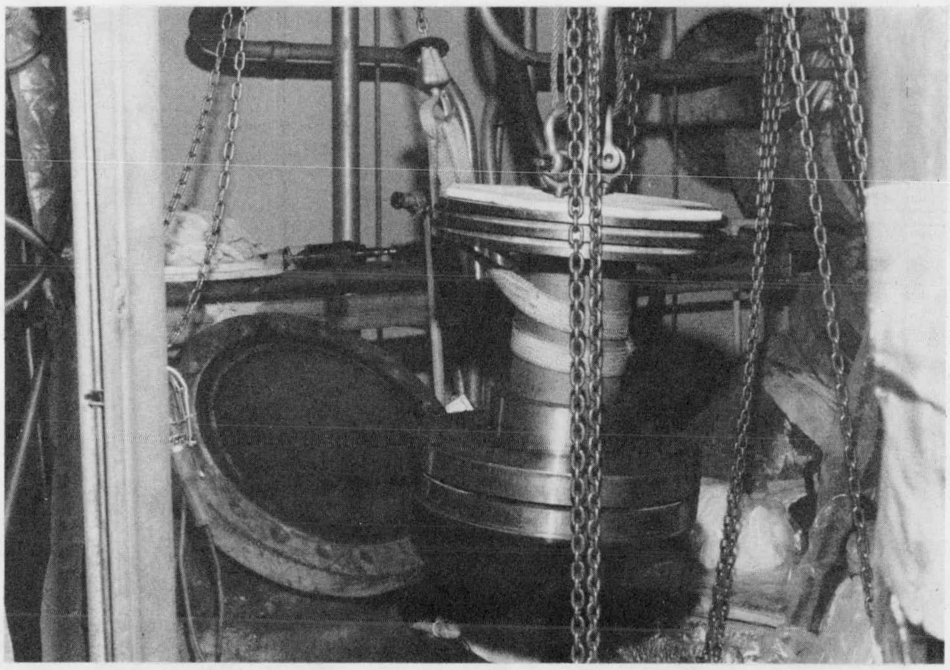


Figure 190. In Process of Spotting in Valve Poppet - Note Blueing on Valve - Rockwell (Fitzpatrick)

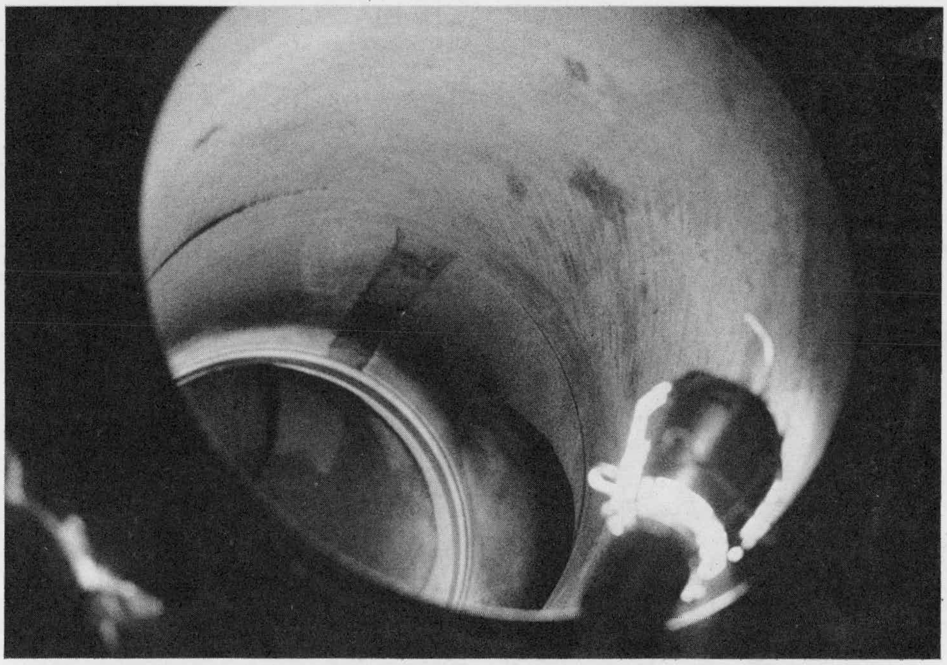


Figure 191. MSIV Seat (Browns Ferry)

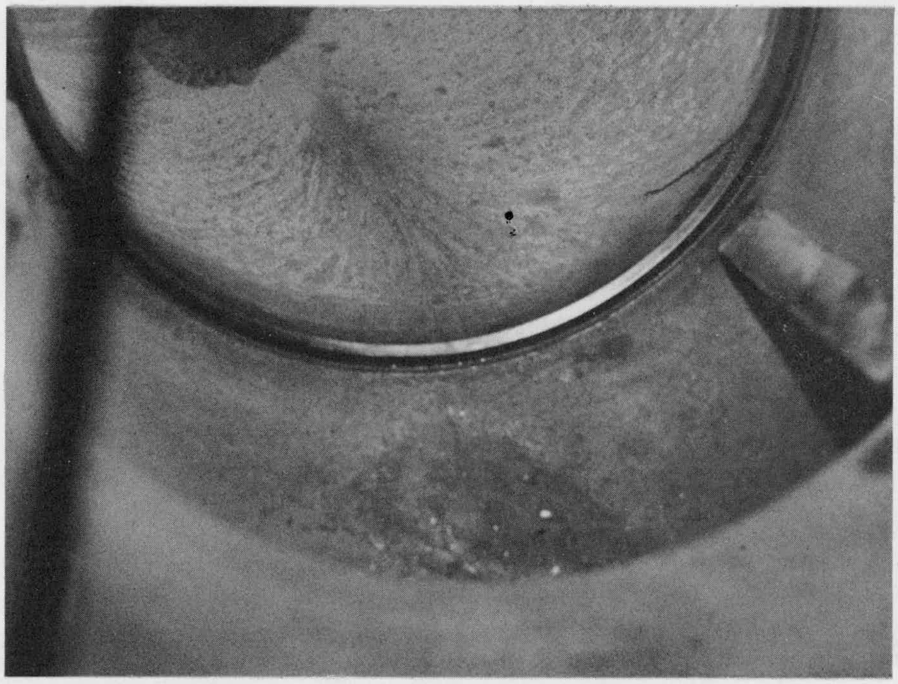


Figure 192. MSIV Seat-Valve Set at 30^{o} off Centerline of Steam Line Causing Galling of Seat Area Between Valve Guides (Browns Ferry)

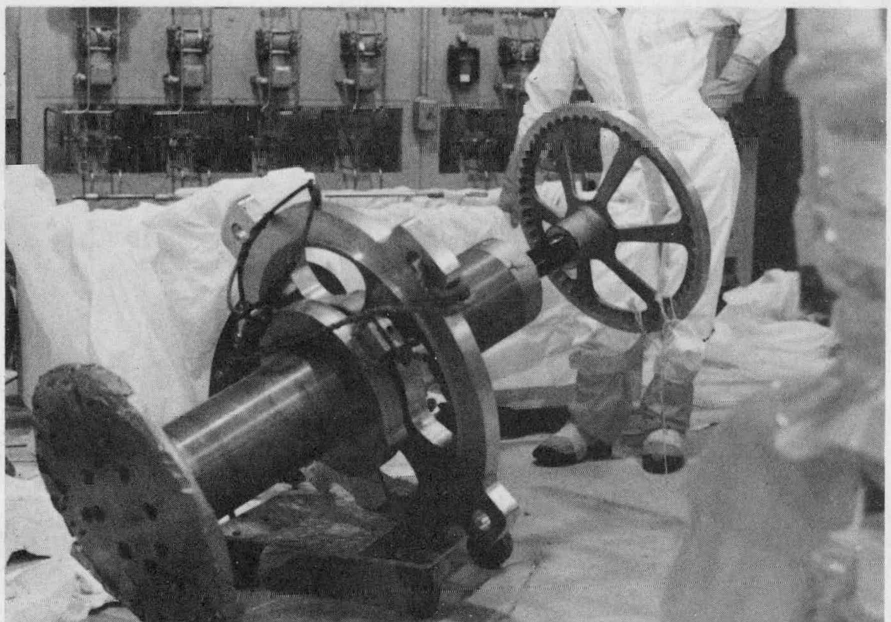


Figure 193. Aluminum MSIV Lapping Tool (Browns Ferry)

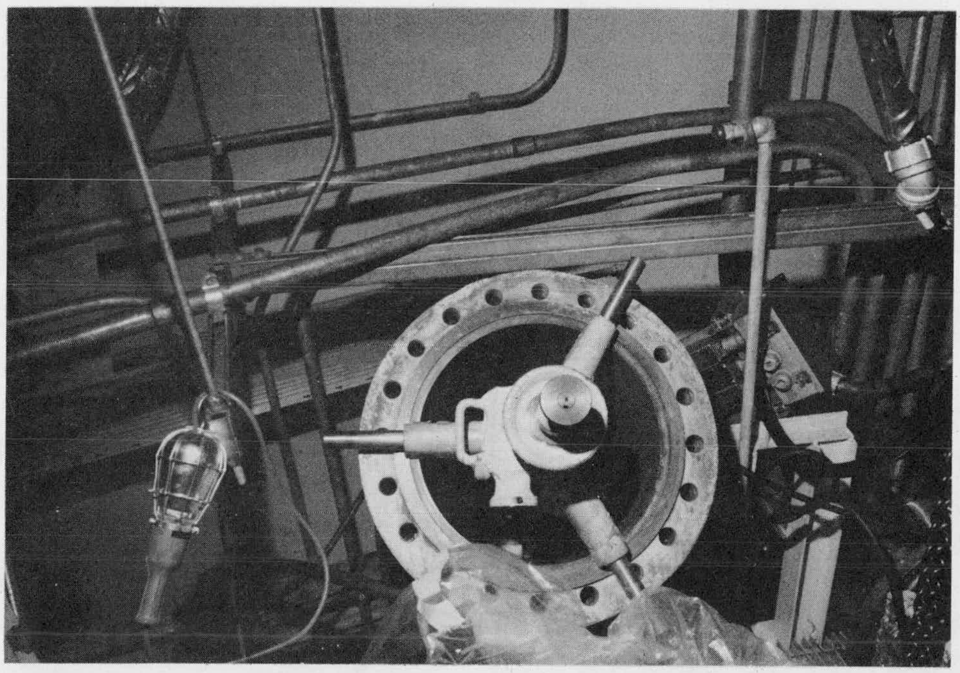


Figure 194. MSIV Lapping Tool (Fitzpatrick)

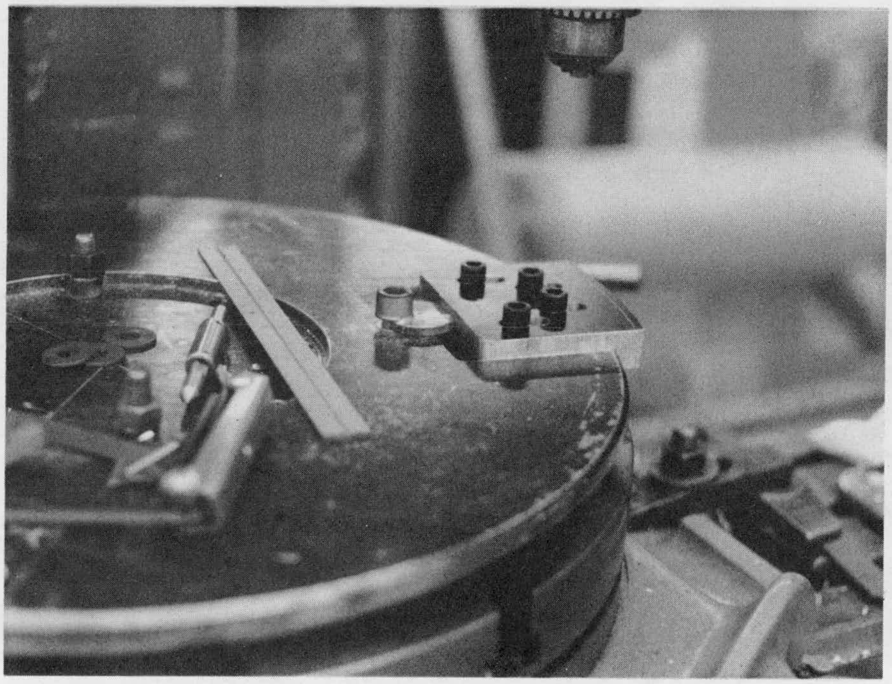


Figure 195. MSIV Lapping Tool in Process of Being Machined - Note Adjustable Holders for Emery Cloth (Browns Ferry)

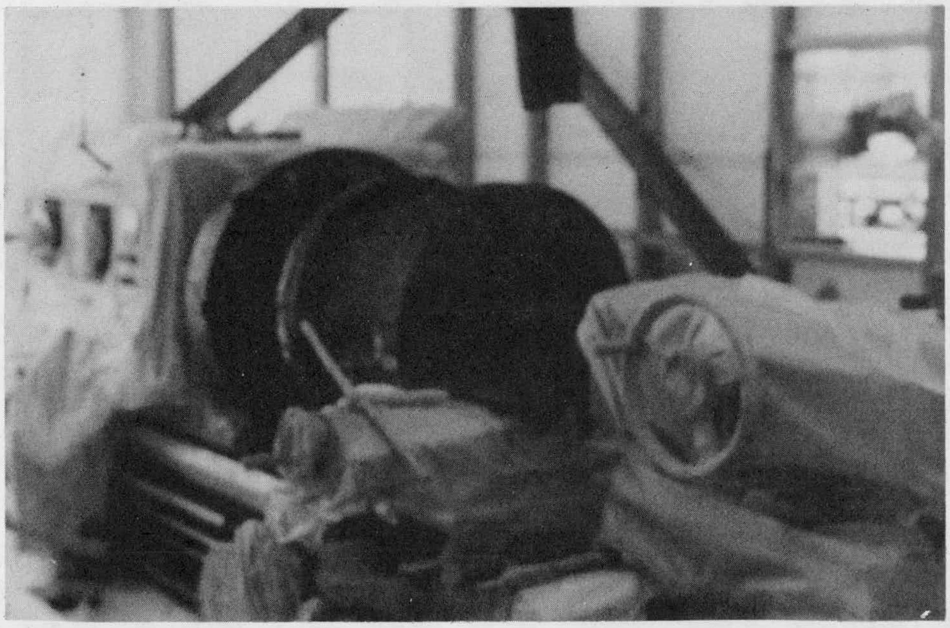


Figure 196. MSIV Poppet in Lathe Making Ready to Clean Up Seat Area (Browns Ferry)

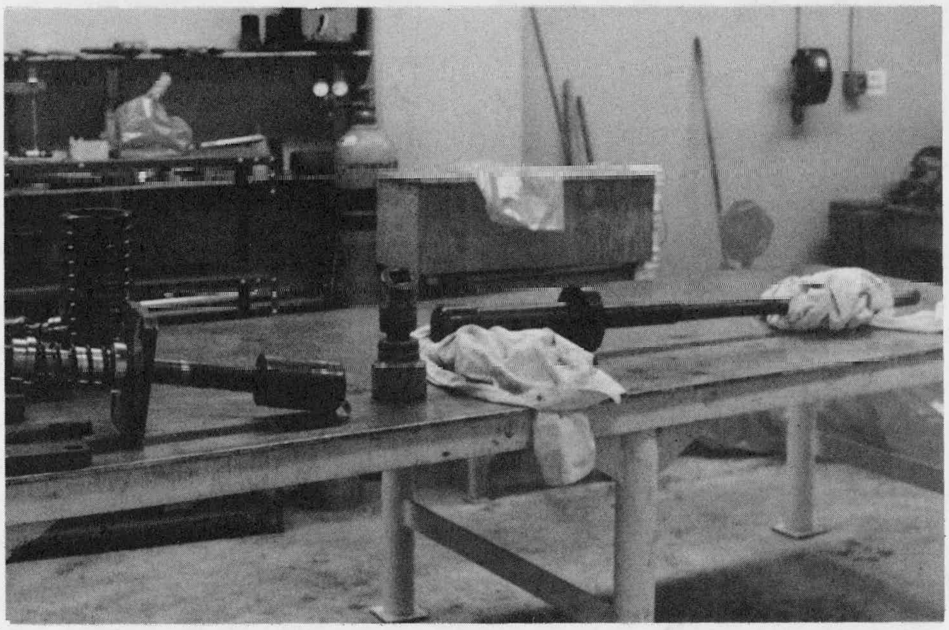


Figure 197. MSIV Pilot Valve Stem (Browns Ferry)

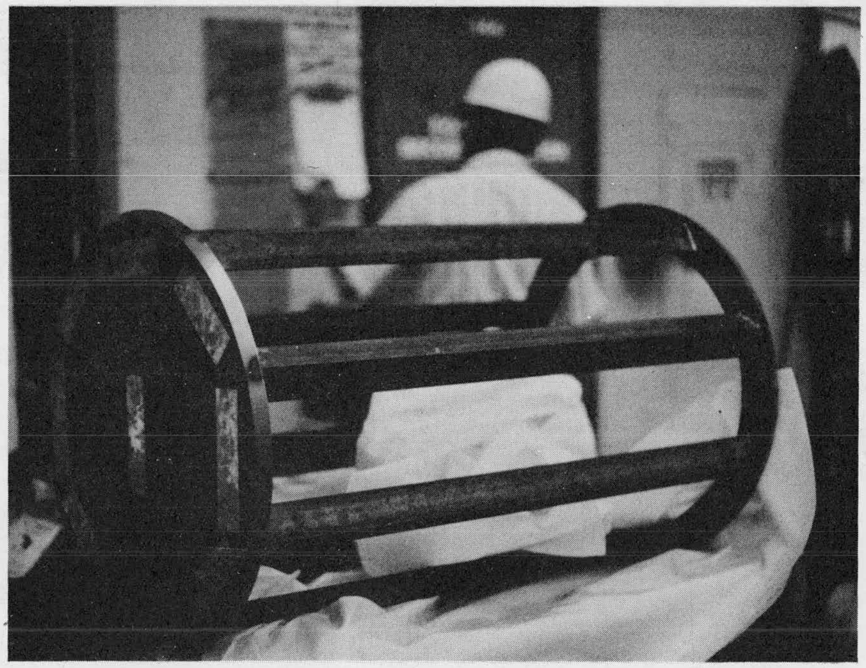


Figure 198. MSIV Inboard Test Plug Fixture (Browns Ferry)

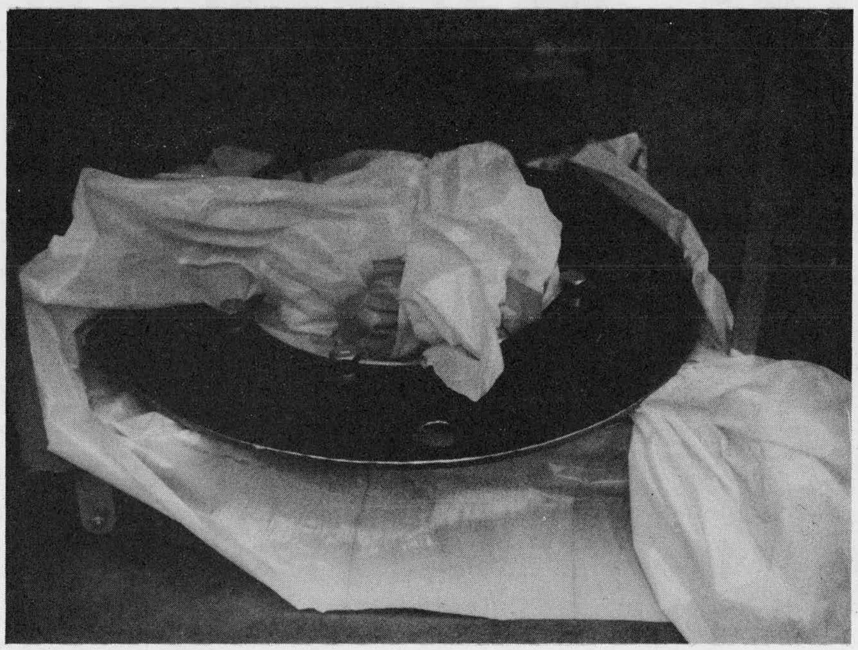


Figure 199. Part of MSIV Test Plug - Poppet Cage Jack Force Plate (Browns Ferry)

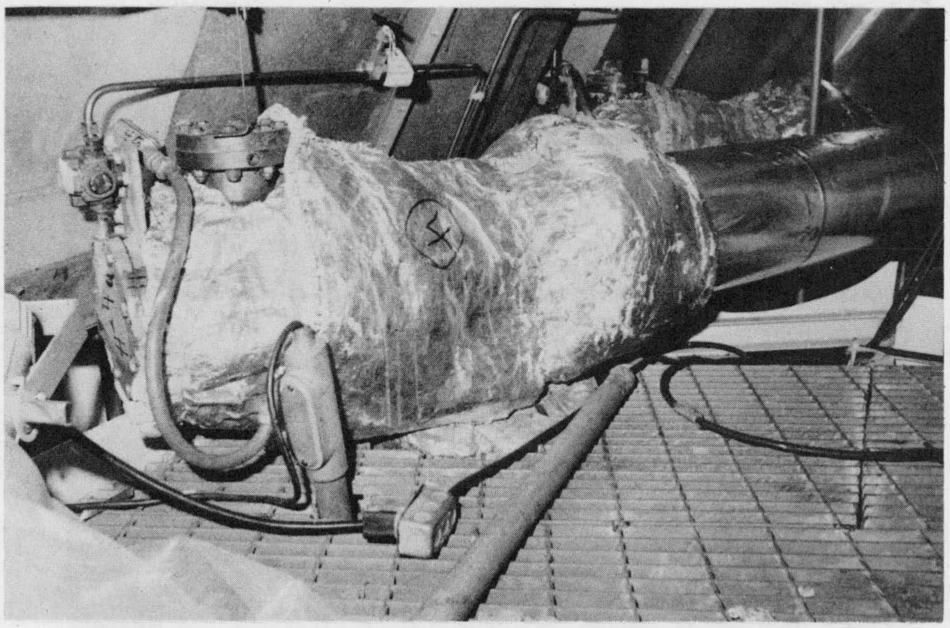


Figure 200. Safety Relief Valve (Fitzpatrick)

Figure 201. SRV (Fitzpatrick)

Figure 202. Open SRV - Left This Way Several Days (Fitzpatrick)

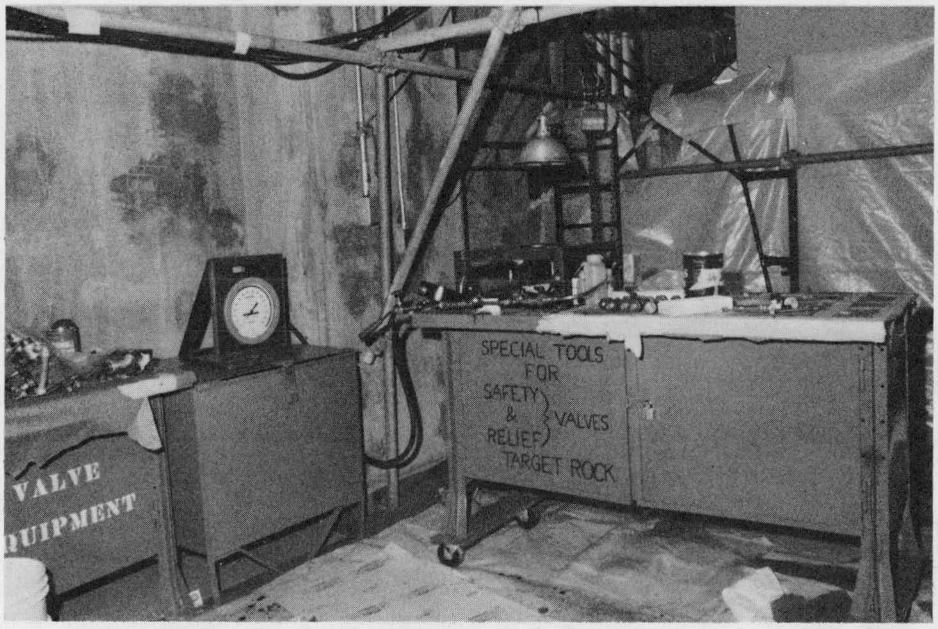


Figure 203. SRV Service Tent in Reactor Building (Fitzpatrick)

Figure 204. SRV Test Trailer (Fitzpatrick)

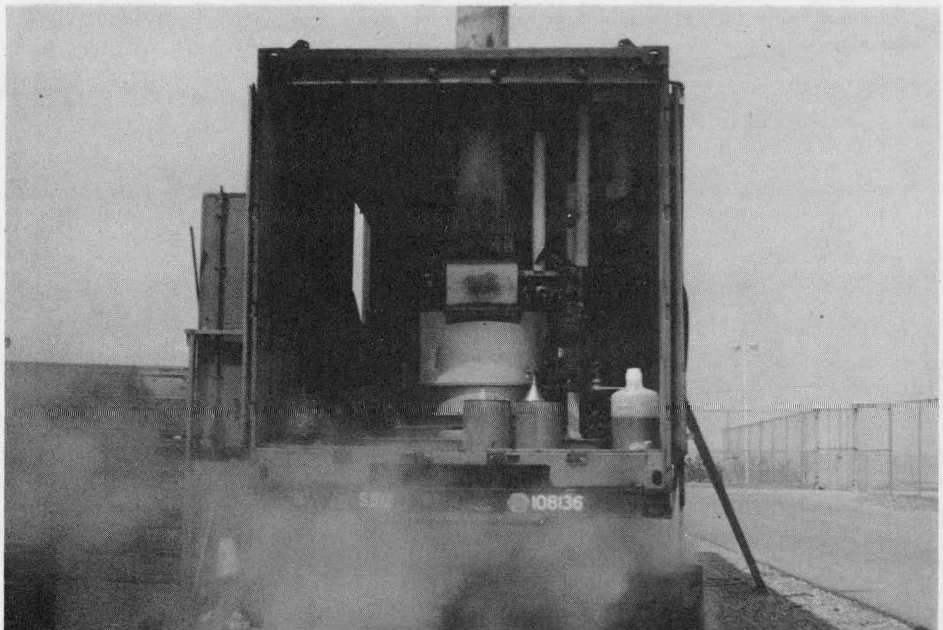


Figure 205. SRV Test Trailer Singer Steam Generator (Fitzpatrick)

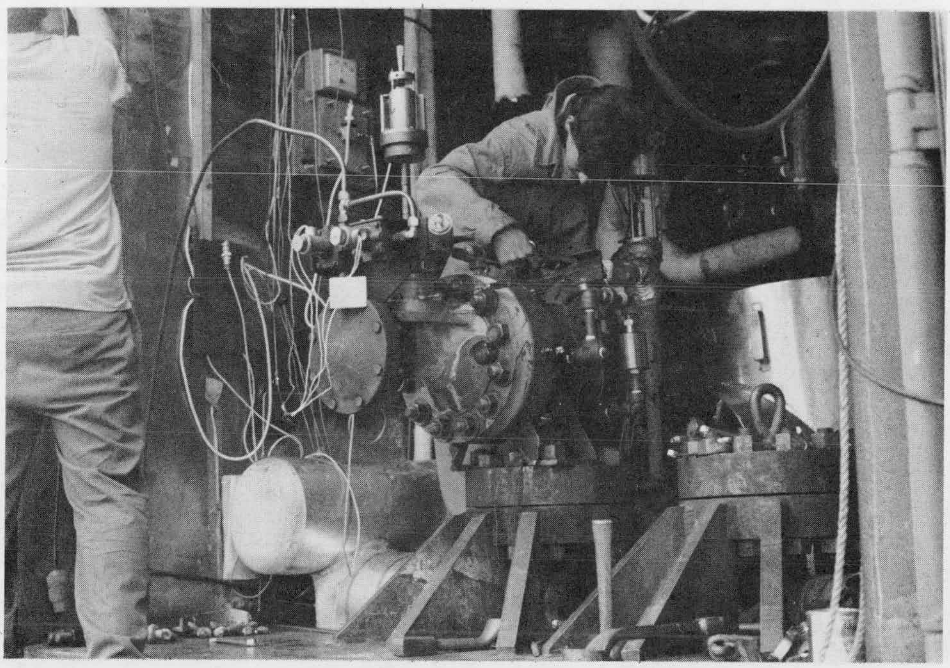


Figure 206. SRV Test Trailer with Test Cell and SRV Prior to Test (Fitzpatrick)

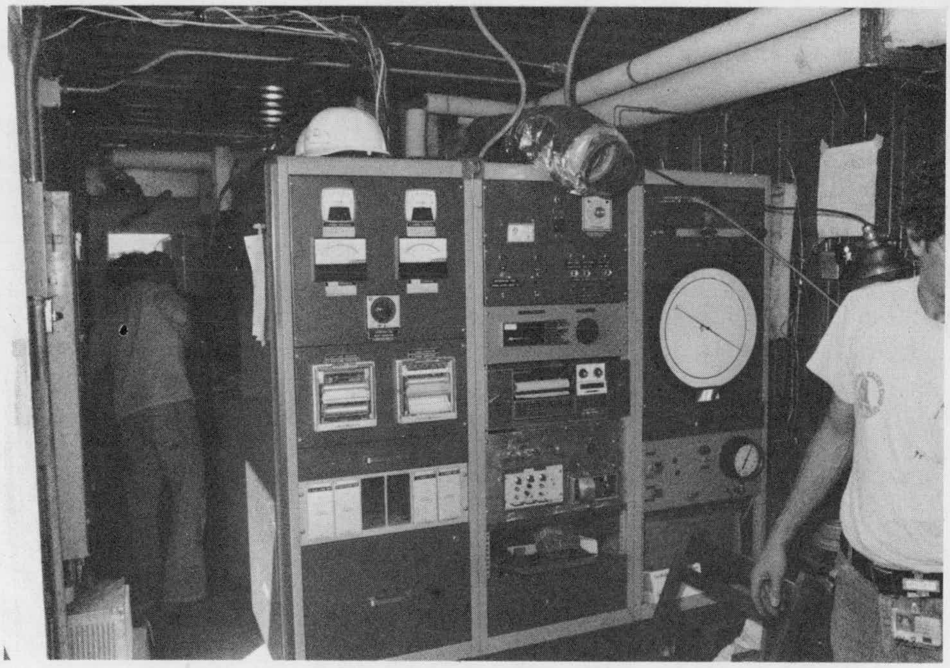


Figure 207. SRV Test Trailer (Fitzpatrick)

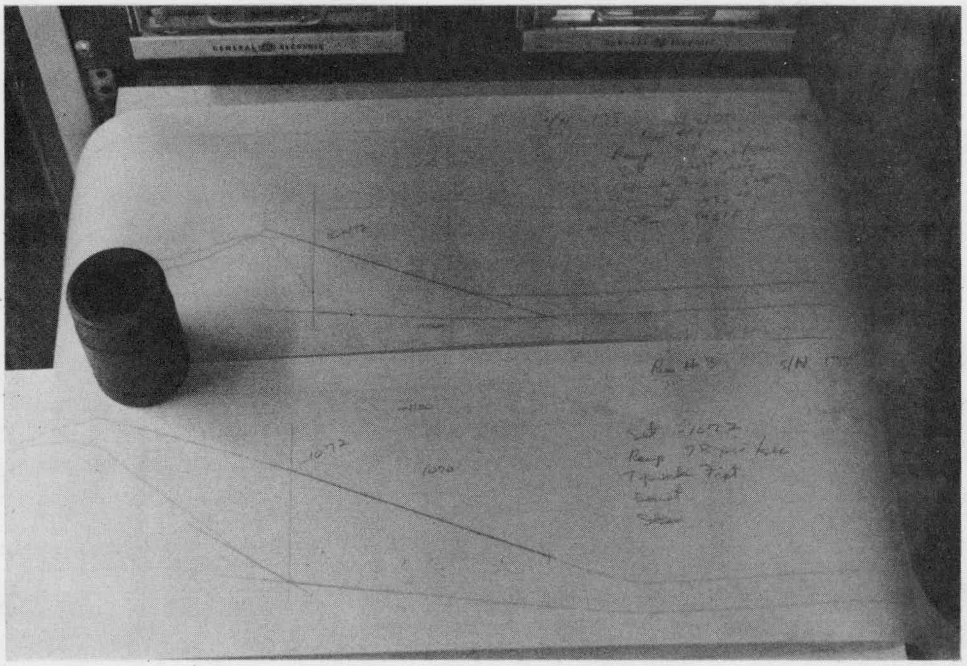


Figure 208. SRV Test Performance Chart (Fitzpatrick)

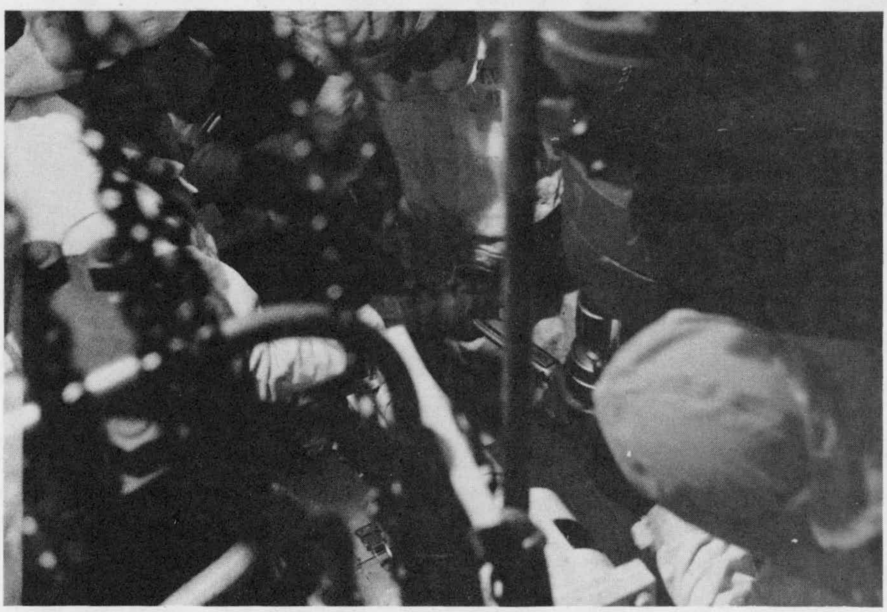


Figure 209. Installing Main Safety Relief Valve (Browns Ferry)

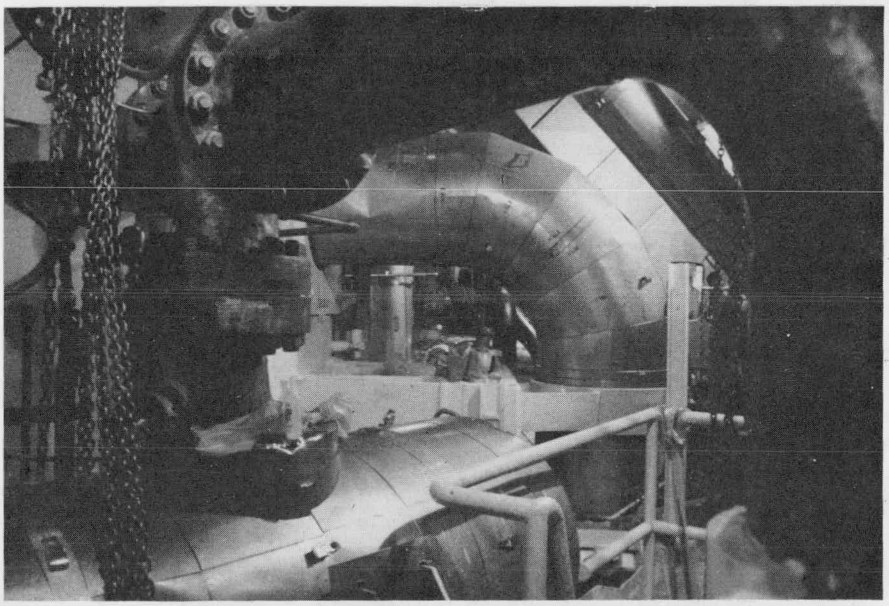


Figure 210. Safety Relief Valve (Browns Ferry)

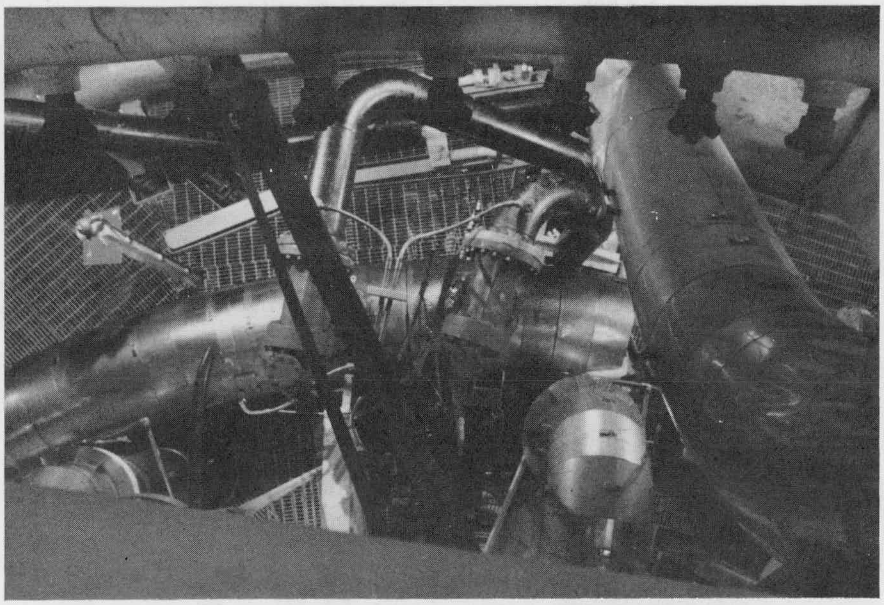


Figure 211. Safety Relief Valves (Browns Ferry)

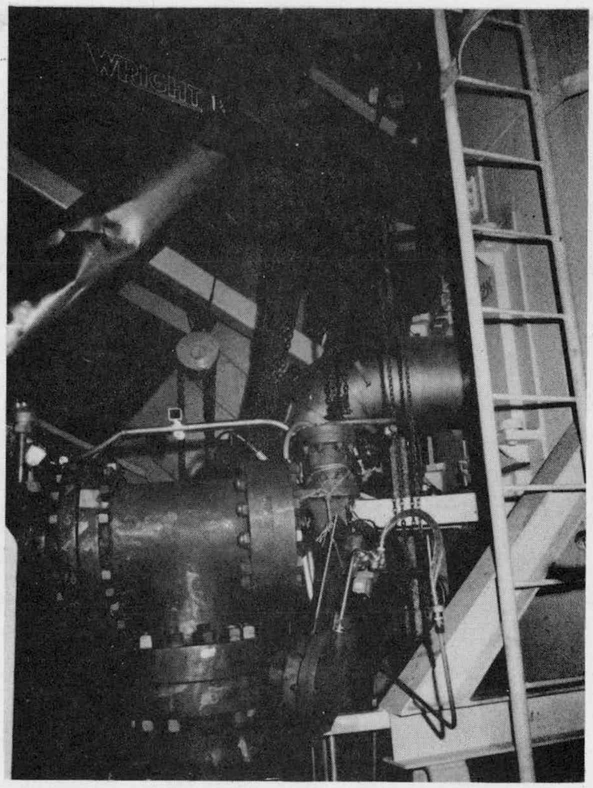


Figure 212. SRV Showing Handling Provisions in Drywell Chain Fall and Jib Crane (Browns Ferry)

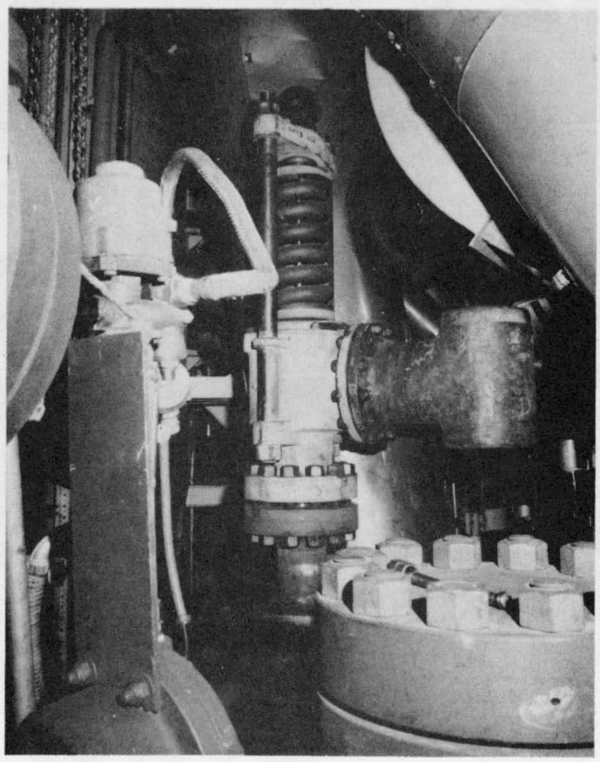


Figure 213. Safety Valve in Position in Drywell (Browns Ferry)

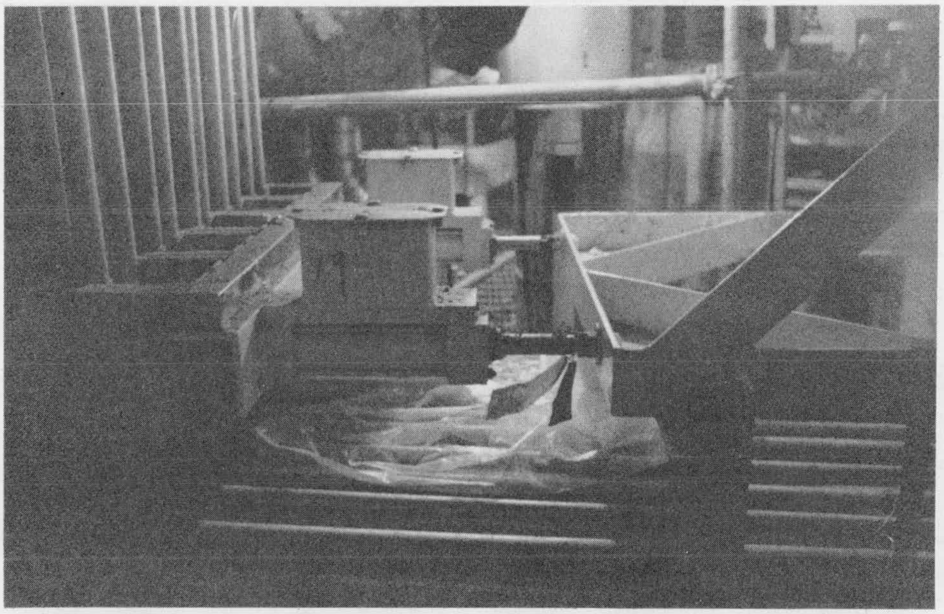


Figure 214. Snubbers in Drywell (Fitzpatrick)

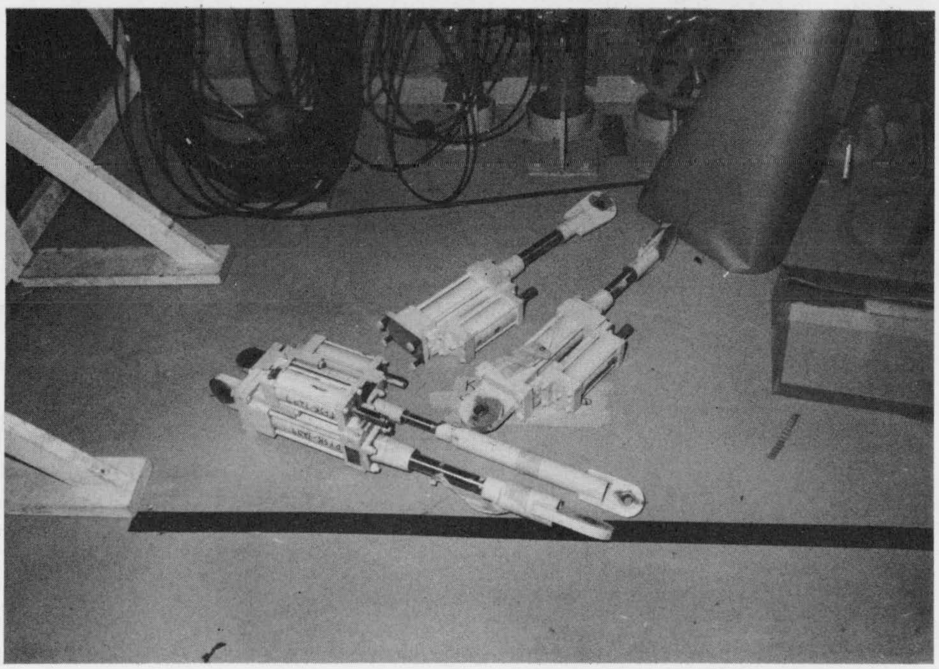


Figure 215. Drywell - Snubbers Removed and Ready for Maintenance (Fitzpatrick)

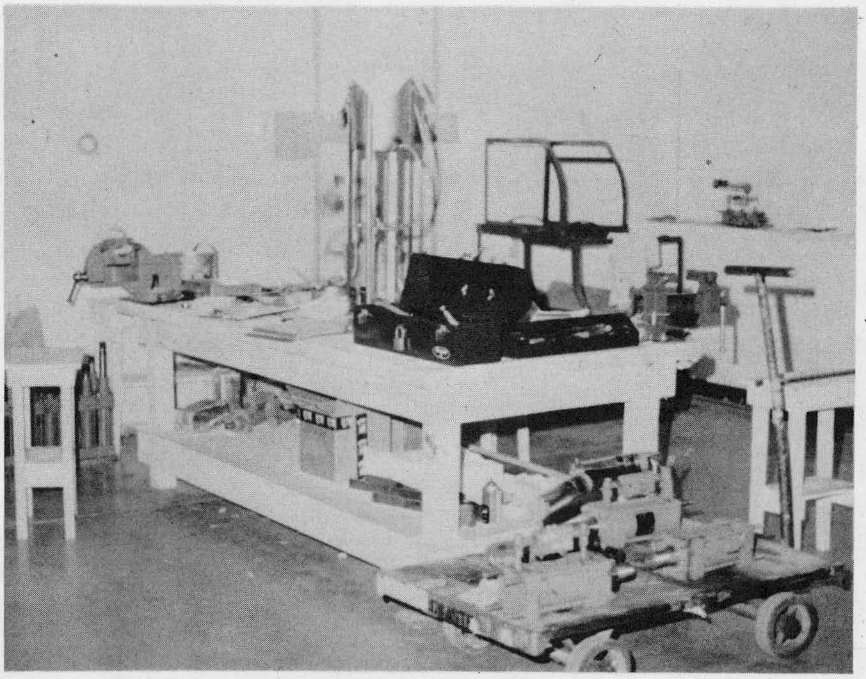


Figure 216. Snubber Overhaul Service Area (Browns Ferry)

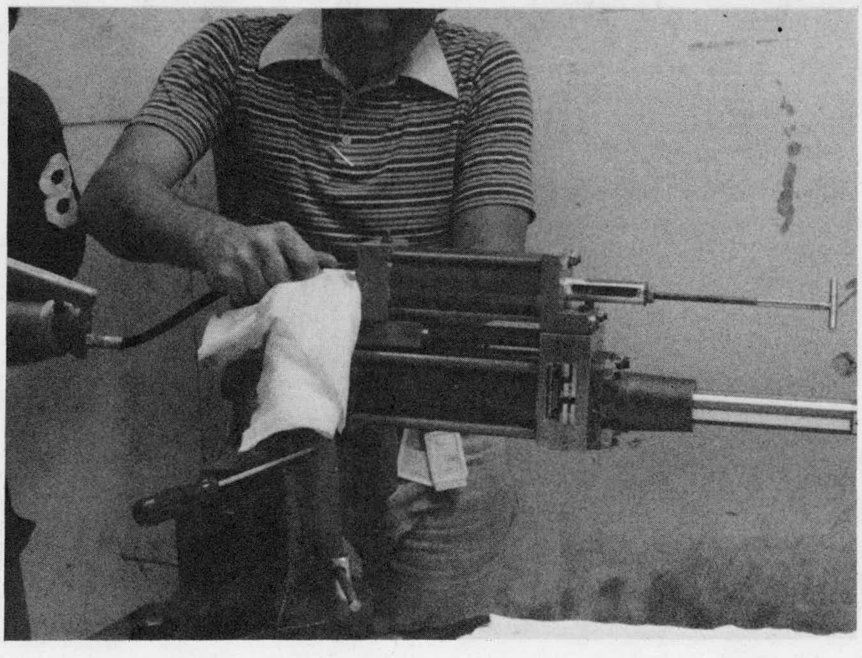


Figure 217. Snubber - In Process of Charging Auxiliary Piston with Hydraulic Oil (Browns Ferry)

Figure 218. Reassembling Hydraulic Snubber (Browns Ferry)

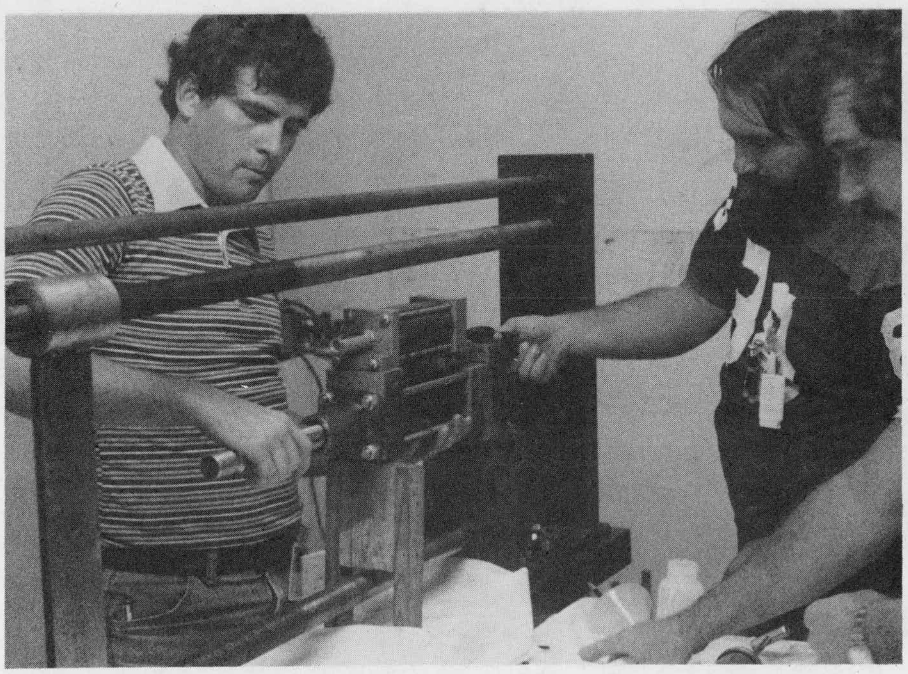


Figure 219. Placing Hydraulic Snubber in Test Stand (Browns Ferry)

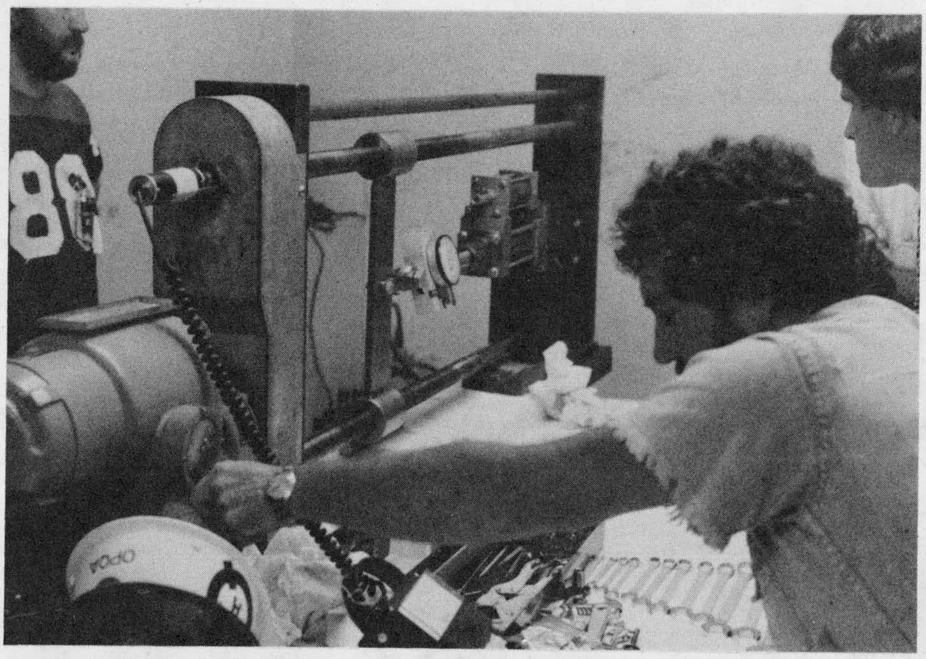


Figure 220. Snubber Test Stand - Increasing Speed and Checking Voltmeter (Browns Ferry)

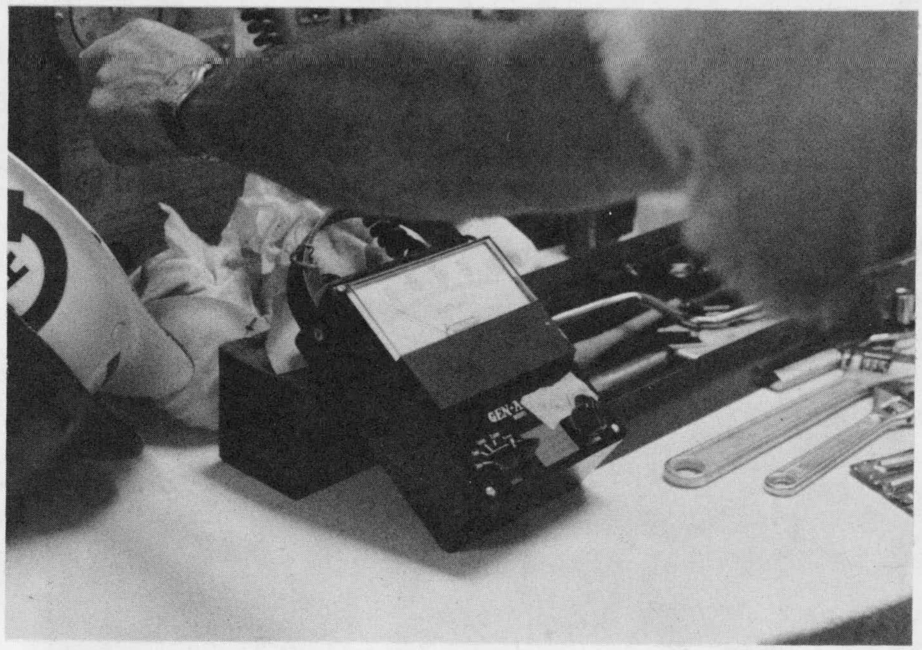


Figure 221. Voltmeter being Used as a Tachometer (Browns Ferry)

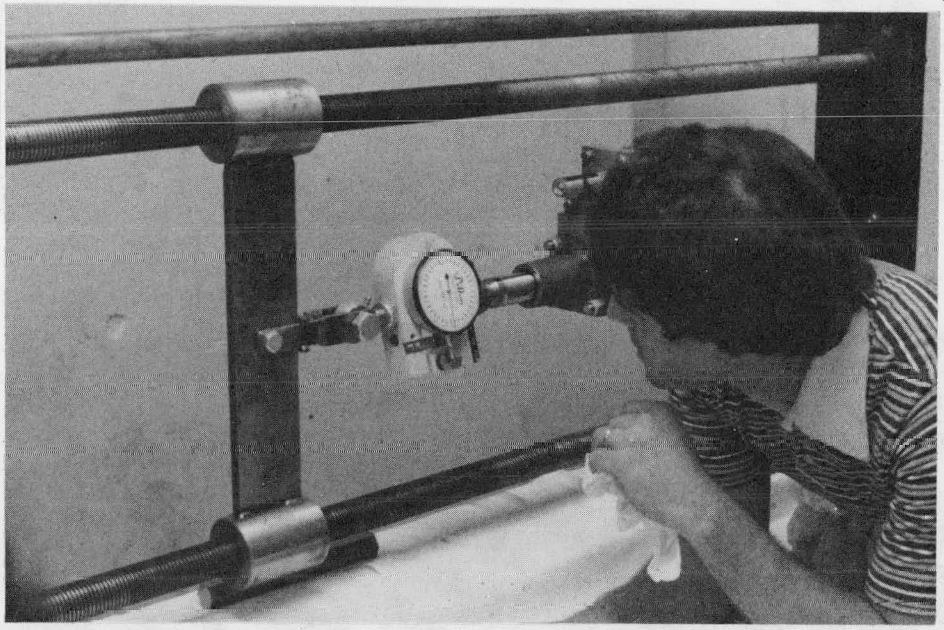


Figure 222. Snubber Test Stand - Reading Force Cell (Browns Ferry)

Figure 223. Snubber Testing - Grimnel Type Snubbers (Fitzpatrick)

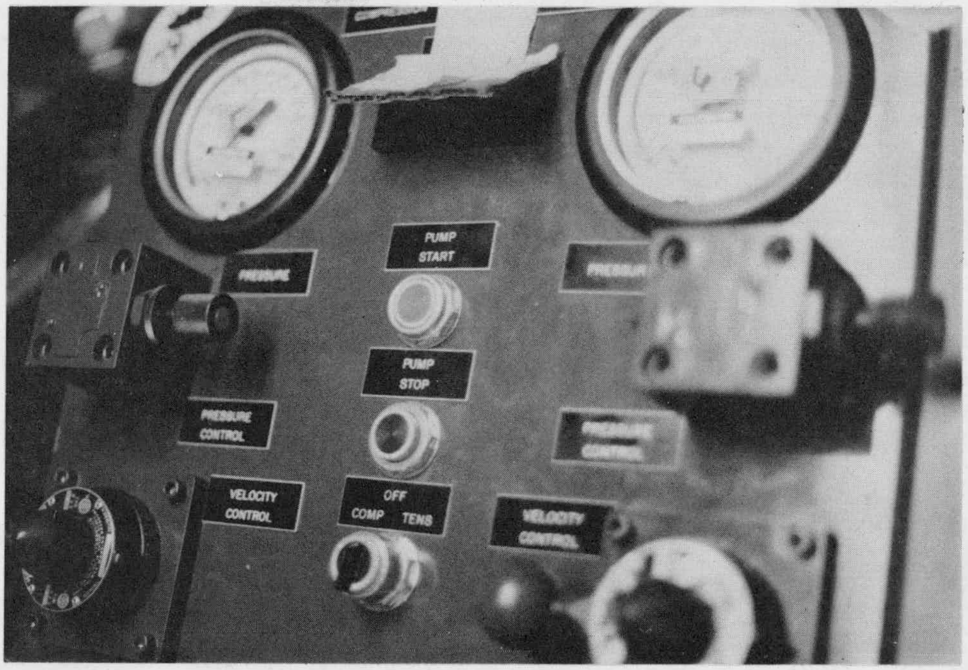


Figure 224. Snubber Test Control Panel (Fitzpatrick)

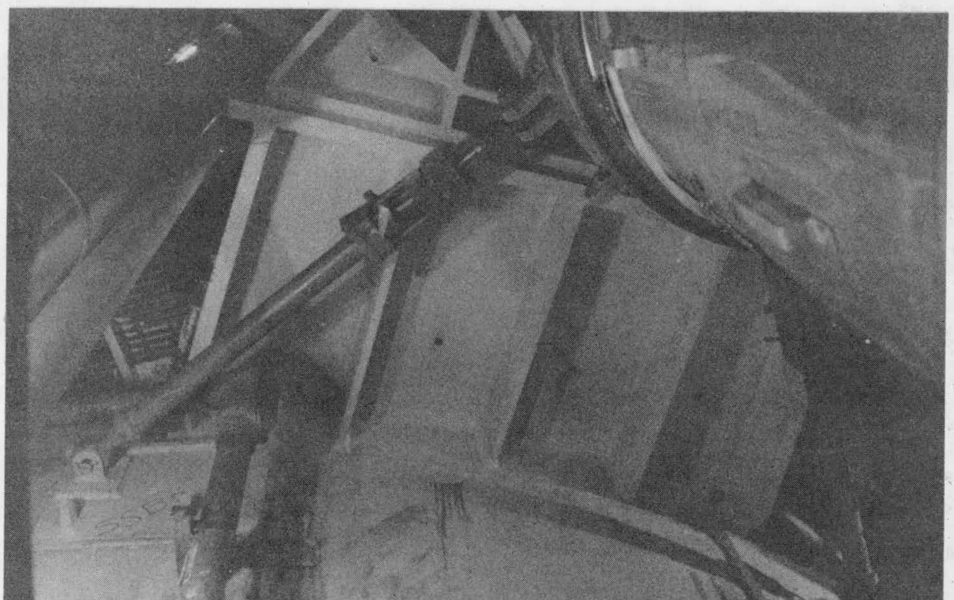


Figure 225. Snubber in Position in Drywell (Fitzpatrick)

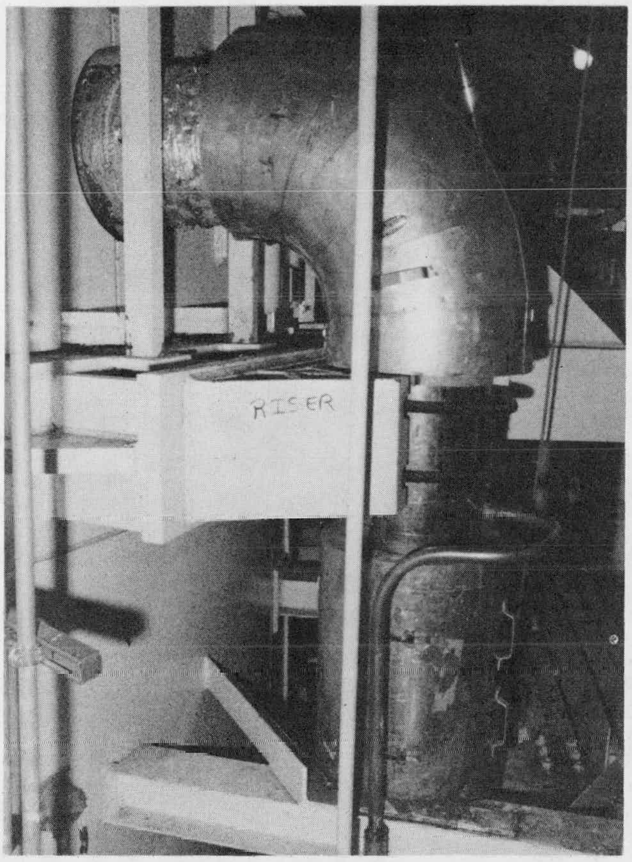


Figure 226. Drywell Piping Insulation Removal for ISI (Fitzpatrick)

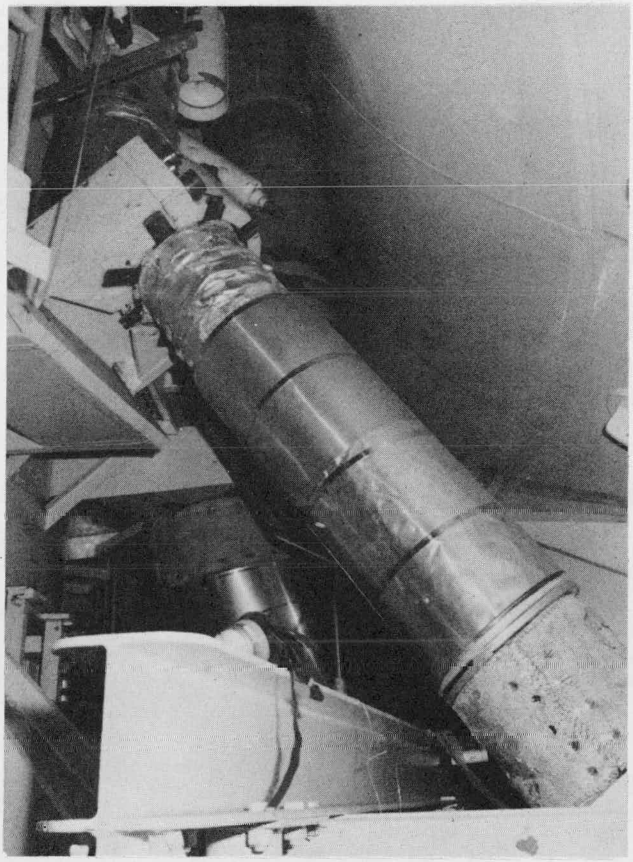


Figure 227. Drywell Piping Insulation Removal for ISI (Fitzpatrick)

Figure 228. Cutting Drywell Piping Insulation (Fitzpatrick)

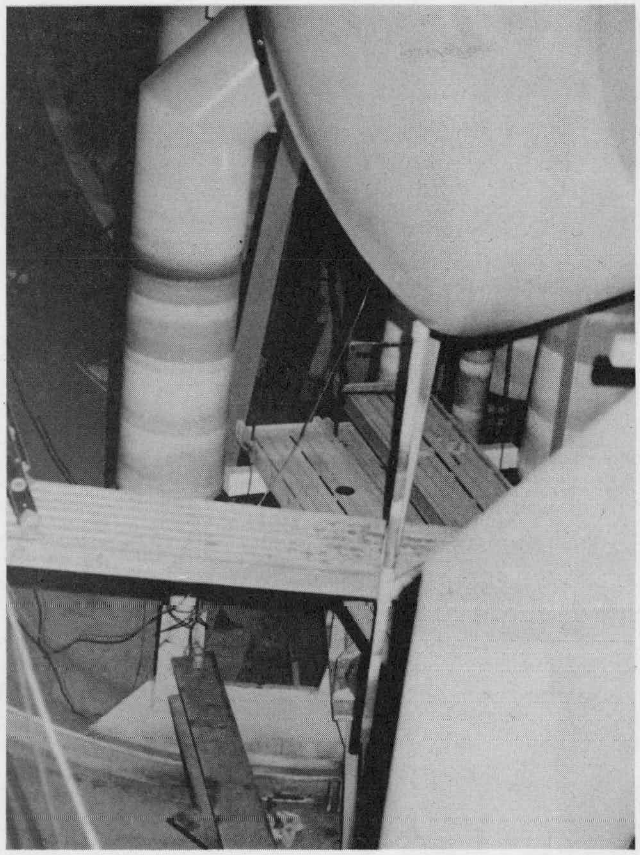


Figure 229. Added Structural Steel to Torus (Browns Ferry)

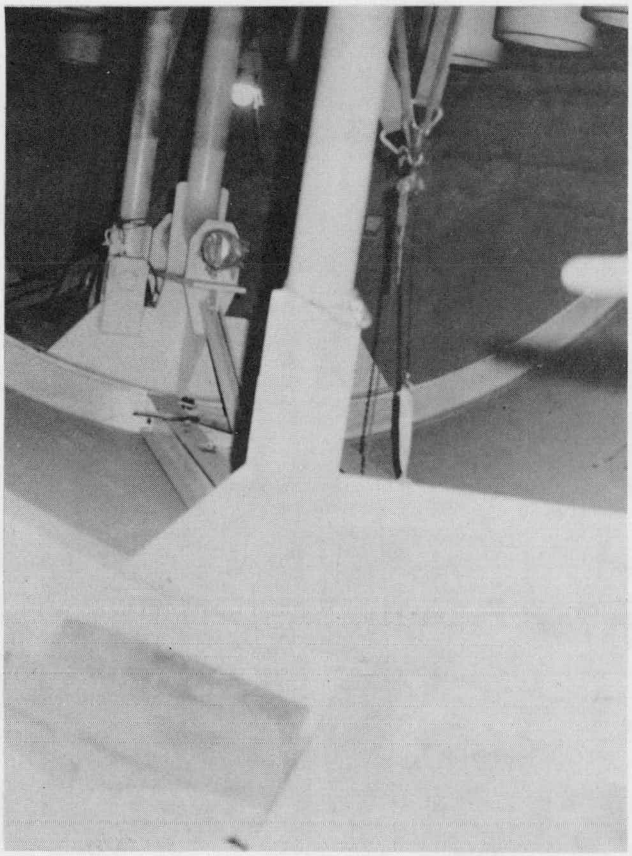


Figure 230. Paint Peeling in Torus (Browns Ferry)

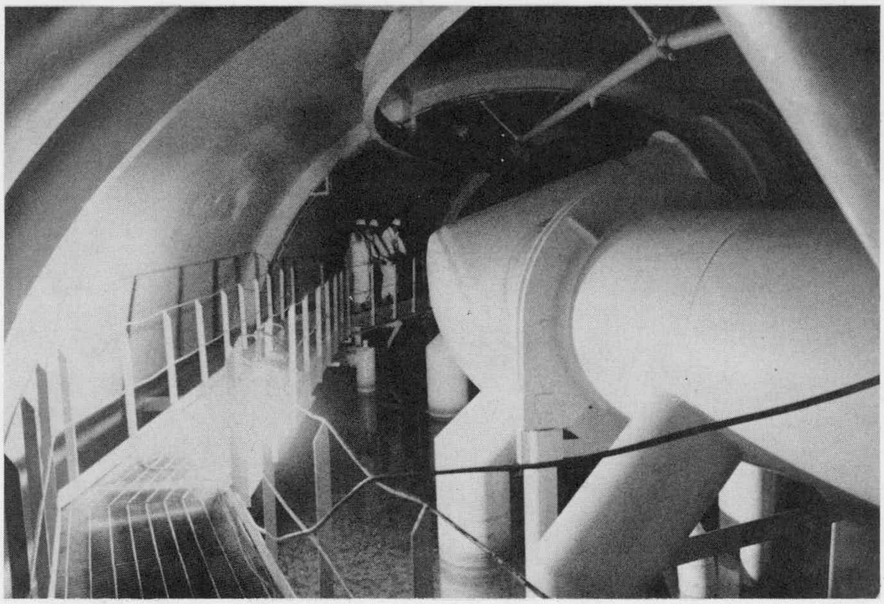


Figure 231. Torus after being Filled with Water (Browns Ferry)

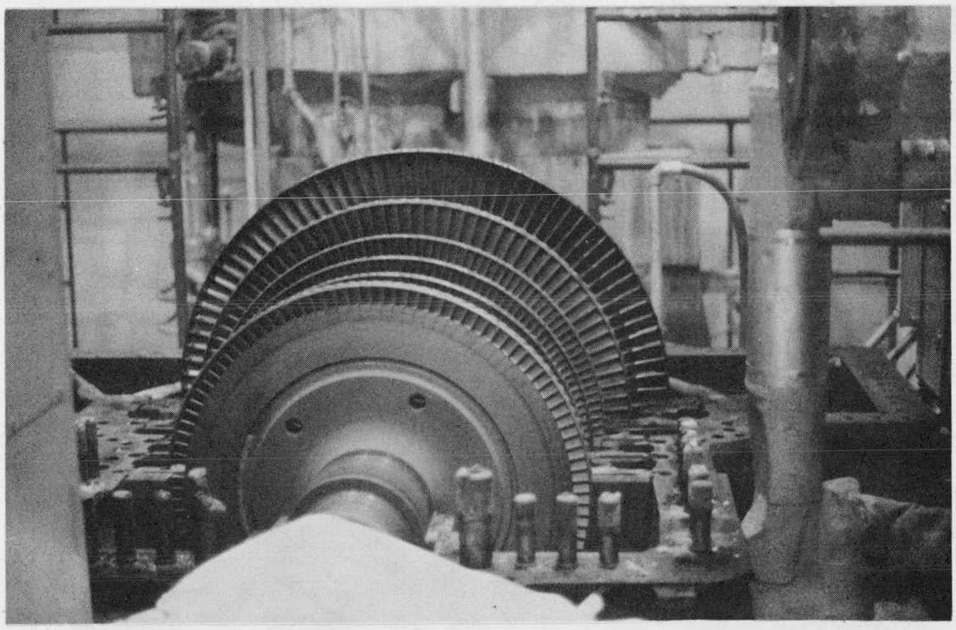


Figure 232. Feed Pump Turbine (Browns Ferry)

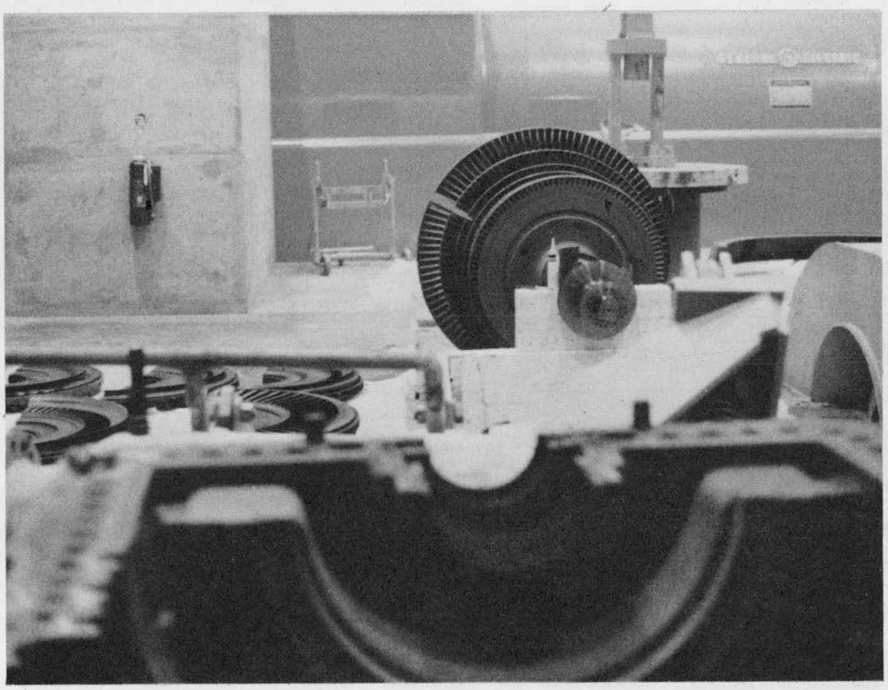


Figure 233. Feed Pump Turbine Rotor and Lower Casing (Browns Ferry)

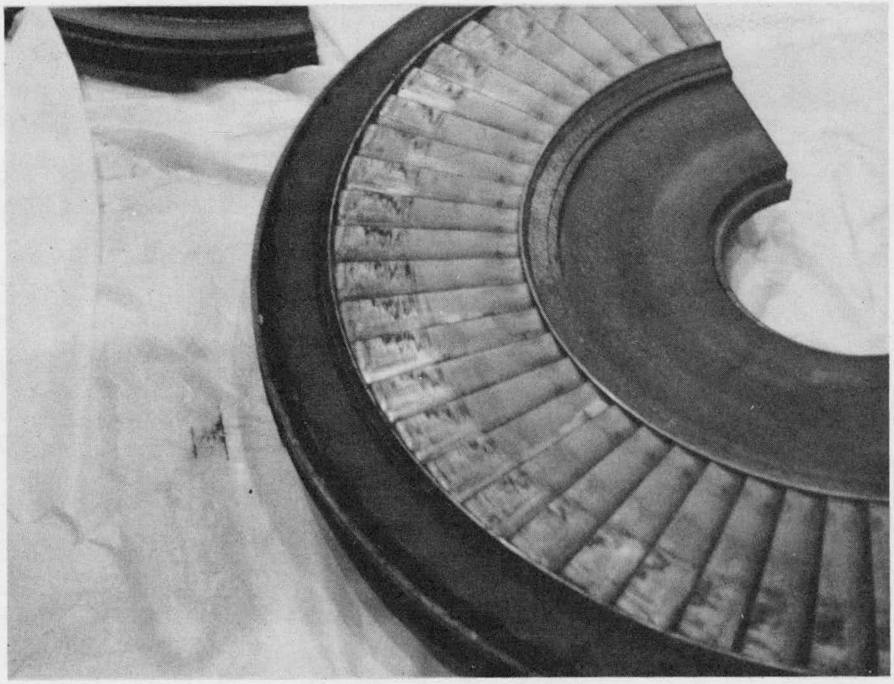


Figure 234. Feed Pump Turbine Diaphragm - Damage Caused by Bolt Keeper Breakage (Browns Ferry)

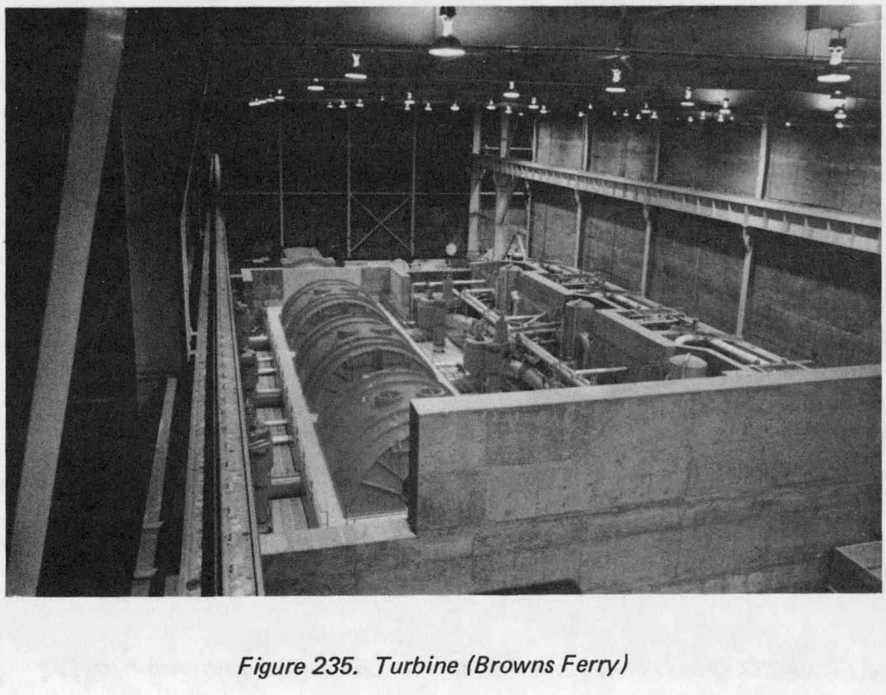


Figure 235. Turbine (Browns Ferry)

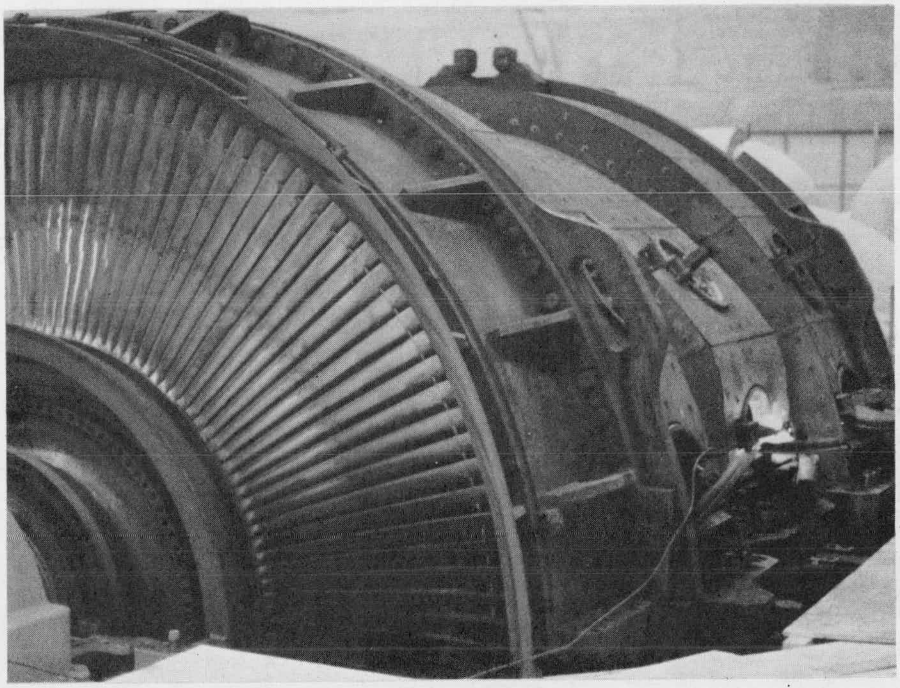


Figure 236. L. P. Turbine (Browns Ferry)

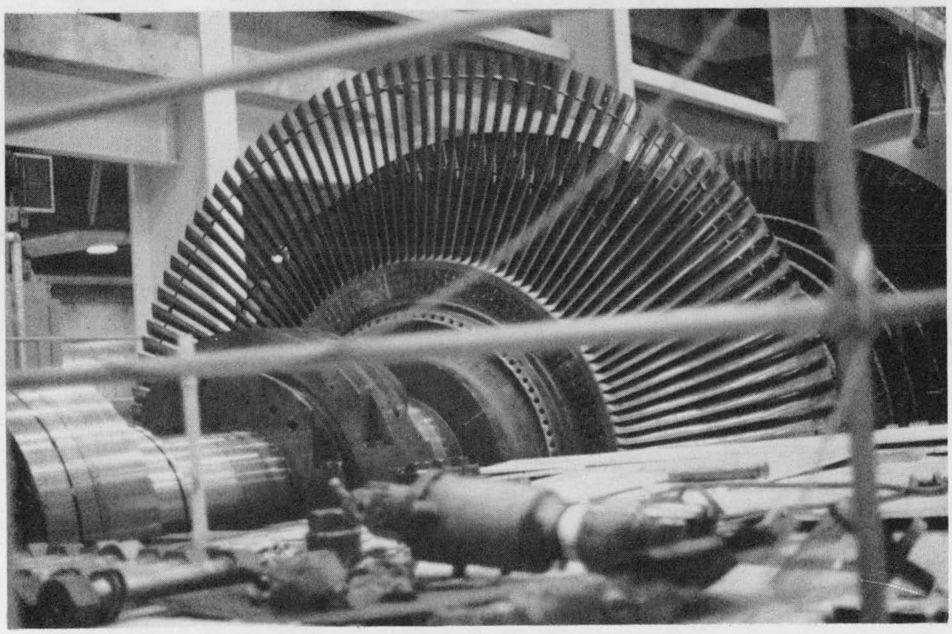


Figure 237. L. P. "A" Turbine (Browns Ferry)

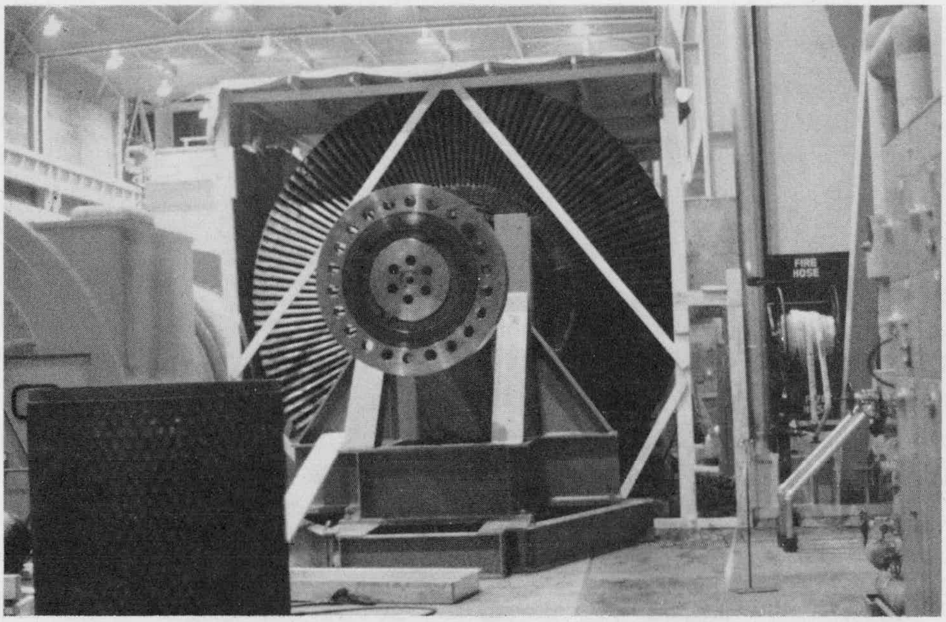


Figure 238. L. P. Turbine Blading (Last Stage) (Browns Ferry)

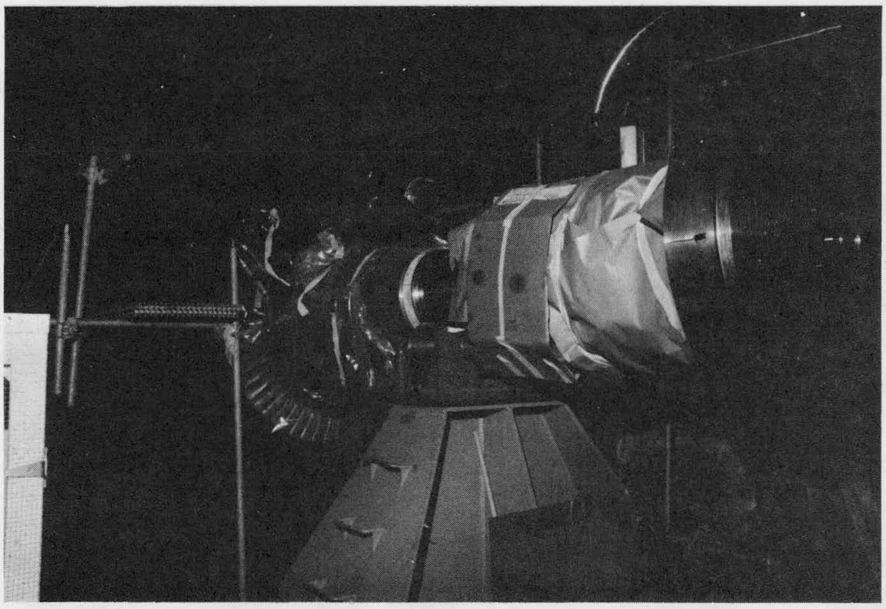


Figure 239. Turbine Coupling (Fitzpatrick)

Figure 240. Turbine Control Valve (Fitzpatrick)

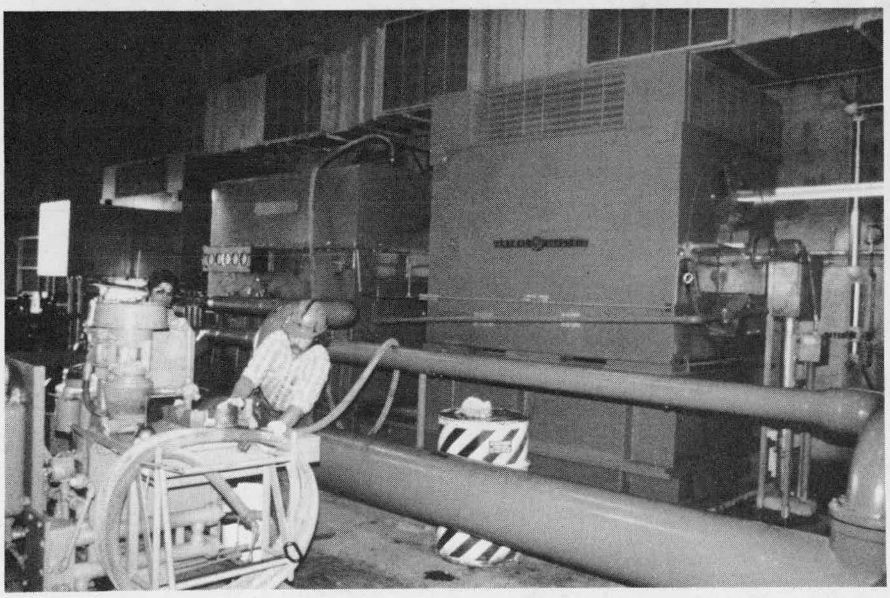


Figure 241. Adding Hydraulic Fluid to M. G. Set (Fitzpatrick)

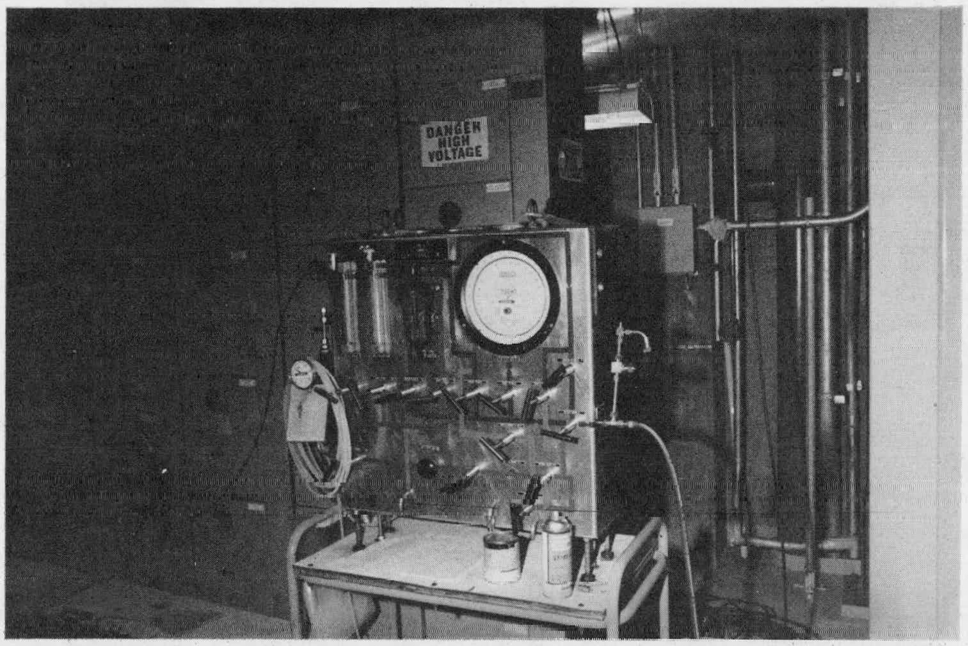


Figure 242. LLRT Panel - Local Leak Rate Test

Appendix B

ACTIVITY SERVICE PLANS

Refueling and Drywell Activity Service Plan forms were provided at each nuclear plant where comments were independently recorded. The comments from the four plants were then combined on a single form for each Activity Service Plan. Individual comments are identified by the following key:

(H) Hatch 1
(QC) Quad Cities 1
(F) FitzPatrick
(BF) Browns Ferry 1

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Activity Service Plans

DRYWELL

ACTIVITY SERVICE PLAN
RF-1

1. Activity Title: Remove Reactor Well Shield Blocks
2. Location: Refueling floor above reactor well
3. Work Description: Inspect and assemble rigging, lay cribbing, rig to lift and store blocks
   (H) Inspect and assemble rigging, rig to lift and store blocks
   (QC) Inspect and assemble rigging, rig to lift and store blocks
   (F) Inspect and assemble rigging, rig to lift and store blocks
   (BF) Inspect and assemble rigging, rig to lift and store blocks
4. Scheduling Information: 4 hours, parallel with cooldown; the first and second layers may be removed prior to reactor shut-down depending on radiation levels
   (H) 3 hours, parallel with cooldown; the first and second layers may be removed prior to reactor shutdown depending on radiation levels
   (QC) 3 hours, parallel with cooldown; the first and second layers may be removed prior to reactor shutdown depending on radiation levels
   (F) 3 hours, parallel with cooldown, only one layer
   (BF) 3 hours, parallel with cooldown; the first and second layers may be removed prior to reactor shutdown depending on radiation levels
5. Manpower
   a. Special Skills: None
   b. Prefabrication: 4 hours, 2 mechanics; prepare laydown area and lay cribbing (as necessary)
      (H) 4 hours, 2 mechanics; no cribbing used
      (QC) None
      (F) 4 hours, 2 mechanics; prepare laydown area (as necessary)
      (BF) 4 hours, 2 mechanics; prepare laydown area and lay cribbing (as necessary)
   c. Performance: 1 qualified rigger, 4 mechanics
      1 HP (part time)
      1 crane operator
      1 supervisor
      (H) 1 qualified rigger, 4 mechanics
      1 HP (part time) full time @ door
      1 crane operator
      1 supervisor
   d. Recovery
6. Special Equipment/Tools - Matched pair of slings
   (H) Two pairs of slings. Pairs are different lengths since each block uses 3 pads. One pair equal length used with 3rd either longer or shorter - shorter for semicircle blocks, longer for square blocks
   (QC) Matched pair of slings. Slings appear to match very well. One sling (of 3) has 3 extra shackels.
   (F) Matched pair of slings, one 4 foot level

7. Material (spare parts, special consumables, etc): Cribbing timbers
   - (H) Cribbing timbers not used. Pry bar used to loosen second layer center block. One corner stuck down.
   - (QC) Cribbing timbers - none used.
   - (F) Rubber pads between floor and blocks for protection of paint on floor.
   - (BF) Cribbing pads
8. Prerequisites: Obtain shift engineer's permission prior to lifting plugs.
   - (F) Obtain shift engineer's permission prior to lifting plugs. Marked laydown areas were cleared and cleaned prior to lifting.
9. Procedures: MMI-24.
10. Periodicity - once each refueling outage.
11. Estimated work area radiation field - 5 mrem/hr
    - (H) 1 mrem/hr
    - (QC) <5 mrem/hr
    - (F) <5 mrem/hr
    - (BF) <5 mrem/hr
12. Total MAN-REM - 5 men x 4 hrs. x 5 mrem = 0.1 MAN-REM
13. Personnel Protection - One set of anti-C clothing
14. Remarks:
    - (H) This job started at 0800 since the work crew started 12-hr shifts then, but this work could have started $\sim$8 hrs earlier when the Rx was SD.

      Consider pictures or drawings of slings and turnbuckles or shackles with labeled components for quick and accurate setup to avoid trial and error method on controlling path.
    - (QC) Crane operator well trained and very smooth.

ACTIVITY SERVICE PLAN
RF-2

1. Activity Title: Remove Equipment Pool Shield Blocks
2. Location: Refueling floor and space between reactor well and equipment pool.
3. Work Description: No work in reactor well. Lay cribbing, rig, remove and store four blocks.
   - (H) No work in reactor well. Rig, remove and store four blocks.
   - (QC) No work in reactor well. Rig, remove and store four blocks.
   - (F) No work in reactor well. Rig, remove and store four blocks.
4. Scheduling Information: 4 hours may be performed in parallel with reactor cooldown.
   - (QC) 1-1/2 hours may be performed in parallel with reactor cooldown.
   - (F) 2-1/2 hours may be performed in parallel with reactor cooldown.
   - (BF) 6 hours may be performed in parallel with reactor cooldown.
5. Manpower
   - a. Special Skills: None
   - b. Prefabrication: 1-1/2 hours, 2 mechanics for laying cribbing.
     - (H) Not done
     - (QC) 2 hr, 4 mechanics; 1 crane operator to install center eye in main hook.
     - (F)
   - c. Performance:
     - 1 qualified rigger
     - 1 HP part time
     - 3 mechanics
     - 1 crane operator
     - 1 supervisor
     - (BF) 1 qualified rigger
       1 HP part time
       4 mechanics
       1 crane operator
       1 supervisor
   - d. Recovery: None
6. Special Equipment/Tools - 2 matched slings, 30 ft. extension ladder for access to lower blocks
   - (H) 2 matched slings, 30 ft extension ladder for access to lower blocks, Rode hook down. 4 matched slings with turnbuckles. Turnbuckles and sling too long according to foreman - crew should have used other sling available.
   - (QC) 2 matched slings, 30 ft. extension ladder for access to lower blocks. Single string back notched to design of block.
   - (F) 2 matched slings, 30 ft. extension ladder for access to lower blocks, rubber pads.
7. Material (spare parts, special consumables, etc). Cribbing timbers.
   - (H) Not used
   - (QC) None used
   - (F) Blocks set on floor
   - (BF) Cribbing pads.
8. Prerequisites: Reactor well plugs must be removed. Hand rails may have to be removed depending on lift of overhead crane.
   - (QC) Reactor well plugs must be removed. Hand rails were all removed.
   - (F) Reactor well plugs must be removed. Lift height was there, but to prevent lifting the blocks excessively high, hand rails were removed.
9. Procedures: MMI-24
10. Periodicity: Twice each every refueling outage.

11. Estimated work area radiation field: 5 mrem/hr
    (H) 2 mrem/hr
    (QC) <5 mrem/hr
    (F) <5 mrem/hr
    (BF) <5 mrem/hr
12. Total MAN-REM: 2 hrs. x 2 men x 5 mrem/hr = 0.02 MAN-REM
    (BF) 2 hrs. x 2 men x 5 mrem/hr = < 0.02 MAN-REM
13. Personnel Protection: 1 set of anti-C clothing
14. Remarks:
    (H) Stop to change rigging - crane broken, elec. called.
    (QC) Use of strong back seems to be easier than slings.
    (BF) Loss time on shift change + HP problems, 2-1/2 hrs.

ACTIVITY SERVICE PLAN
RF-3

1. Activity Title: Remove Fuel Pool Shield Blocks
2. Location: Refueling floor and space between fuel pool and reactor well.
3. Work Description: Rig, lift, and store blocks.
4. Scheduling Information: 2 hours. Could possibly parallel with other work at the separator pool side of the well.
   (QC) 1 hour. Could possibly parallel with other work at the separator pool side of the well.
   (F) <1 hour. Could possibly parallel with other work at the separator pool side of the well.

4. Manpower
   a. Special Skills: None
   b. Prefabrication: None
   c. Performance:
      1 qualified rigger
      2 mechanics
      1 crane operator
      1 supervisor
      1 HP part time
   d. Recovery: None
6. Special Equipment/Tools - 30 ft. extension ladder, 4 matched chokers 20 ft. long
   (QC) Rode hook, 1 choker, 20 ft. long.
   (F) 30 ft. extension ladder, 2 matched chokers, 8 ft. long.
7. Material (spare parts, special consumables, etc): None
8. Prerequisites: Reactor well plugs must be removed.
9. Procedures: MMI-24.
10. Periodicity: Twice each refueling outage.
11. Estimated work area radiation field - 50 mrem/hr
    (QC) < 5 mrem/hr
    (F) < 5.0 mrem/hr
    (BF) < 50 mrem/hr
12. Total MAN-REM: None. 2 men x 1 hr. x 50 mrem/hr = 0.1 MAN-REM
    (BF) None. 2 men x 1 hr. x 50 mrem/hr = <0.1 MAN-REM
13. Personnel Protection: 1 set of anti-C clothing
14. Remarks:
    (QC) Measured after PPU head and dryer were removed and separator exposed.

ACTIVITY SERVICE PLAN
RF-4

1. Activity Title: Unbolt Drywell Head
2. Location: Inside reactor well
3. Work Description: Unbolt drywell head and store bolts.
   - (F) Unbolt drywell head and store bolts. Bolts removed from head and moved to floor separate from DW head removal.
   - (BF) Unbolt drywell head and store bolts. Bolts are stored on drywell head in brackets provided.
4. Scheduling Information: 6 hours
   - (H) 3 hours. 64 bolts. This job should take precedence over E/P blocks as they can be removed while working RPV head piping.
   - (QC) 2 hours.
   - (F) 5 hours.
   - (BF) 4-1/2 hours
5. Manpower
   - a. Special skills: None
   - b. Prefabrication:
     - (F) Preop Air Wrenches.
   - c. Performance
     - 8 mechanics
       1 crane operator
       1 supervisor
       1 HP part time
     - (H) 2 mechanics
       1 crane operator
       1 supervisor
       1 HP part time
     - (QC) 6 mechanics on, 3 off
       1 crane operator
       1 supervisor
       1 HP part time
     - (F) 4 mechanics
       1 crane operator
       1 supervisor
       1 HP part time
     - (BF) 5 mechanics
       1 crane operator
       1 supervisor
       1 HP part time
       Used 10 men rotating in groups of 5 relieving in place
   - d. Recovery: None
     - (F) Procedure should require, on a time available basis, inspect and lube of bolts, nuts, washers.
6. Special Equipment/Tools: 2 1-1/2" impact wrench air drives with hoses (or electric drive wrenches), two basket wrenches.
   - (H) 1 1-1/2" impact wrench air drive with hoses (or electric drive wrenches), two basket wrenches
   - (QC) 2 1-1/2" impact wrench air drives with hoses (or electric drive wrenches).
   - (F) 2 1-1/2" impact wrench air drives with hoses (or electric drive wrenches), two basket wrenches. One wrench burnt out approximately 3/4 of way done. No replacement available. Did not hurt schedule appreciably because most bolts were already done.

7. Material (spare parts, special consumables, etc.): None
8. Prerequisites: Drywell atmosphere meets opening requirements; standby gas treatment operable; hold order issued for containment N_2 purge.
   (F) Drywell atmosphere meets opening requirements; standby gas treatment operable; hold order issued for containment N_2 purge. Rx at 0 psig and temp. less than 212°F.
9. Procedures: MMI-2.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 50 mrem/hr
    (H) 5 mrem/hr
    (QC) 5 mrem/hr
    (F) 2 mrem/hr
12. Total MAN-REM - 9 men x 3 hrs. x 50 mrem/hr = 1.35 MAN-REM
    (F) 5 men x 3 hrs x 2 mrem/hr = .30 MAN-REM
    (BF) 5 men x 3 hrs x 50 mrem/hr = 1.35 MAN-REM
13. Personnel Protection: Possibly 2 sets of Anti-C clothing
    (F) 1 set of Anti-C clothing.
14. Remarks: Grating is lifted as required during unbolting.
    (H) At 400 lost suction on RPV
    (QC) Grating is lifted as required during unbolting. Grating had been flooded due to not placing covers over fuel pool scupper openings plus water level alarms were not working. About 3 hrs. loss. Had to wait for HP to survey area - 1 hr.
    (F) Grating is lifted as required during unbolting. No grating in place.

ACTIVITY SERVICE PLAN
RF-5

1. Activity Title: Rig and Lift Drywell Head
2. Location: Reactor Well and refueling floor.
3. Work Description: Lay cribbing; inspect and adjust strongback; rig, lift, and store drywell head.
   - (F) Inspect and adjust strongback; rig, lift, and store drywell head.
4. Scheduling Information: 3 hours
   - (H) 2 hours
   - (F) 4 hours
   - (BF) 30 min.
5. Manpower
   - a. Special Skills: None
   - b. Prefabrication: 1-1/2 hours, 2 mechanics to lay cribbing.
     - (H) 15 minutes by 8 mechanics
     - (QC) 45 minutes, 2 mechanics to lay cribbing.
     - (F) 1-1/2 hours
   - c. Performance:
     - 4 mechanics
       1 supervisor
       1 crane operator
       1 HP (part time)
     - (H) 6 mechanics
       1 supervisor
       1 crane operator
       1 HP (part time)
   - d. Recovery: None
6. Special Equipment/Tools: Cribbing timbers, strongback, ladder.
   - (H) Cribbing timbers, strongback with only one set ot turnbuckles on DW. RPV heads good, ladder.
   - (F) Flange protectors, strongback, ladder.
   - (BF) Cribbing timbers, strongback, ladder. Drywell head pad eyes and lifting rig turnbuckles are color coded.
7. Material (spare parts, special consumables, etc.): None
8. Prerequisites: Drywell head unbolted; laydown area established; and cribbing in place.
   - (F) Drywell head unbolted; laydown area established; and head placed on top of shield plugs. Incorrectly positioned so that DW head was supported by sealing surfaces.
9. Procedures: MMI-2
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 50 mrem/hr
    - (H) 5 mrem/hr
    - (QC) <5 mrem/hr
    - (F) 1 mrem/hr
    - (BF) 2 mrem/hr
12. Total MAN-REM - 4 men x 1 hr. x 50 mrem/hr = 0.2 MAN-REM

13. Personnel Protection: Possibly two sets of Anti-C clothing for Reactor Well.
    (F) One set of Anti-C clothing for Reactor Well.
14. Remarks: Ensure O-rings sets are on site.
    (H) Ensure O-rings sets are on site (removed cavity ladder) installed temporary ladder. Two men went underneath the D/W head as it was lifted. Unnecessarily dangerous.

ACTIVITY SERVICE PLAN
RF-6

1. Activity Title: Remove Head Spray and Vent Line Piping
2. Location: Inside Reactor well and top elevation of drywell.
3. Work Description: Remove insulation head piping; unbolt five flanges; install blind flanges; remove pipe restraints; rig, lift, and store head spray line.
   (F) Remove insulation head piping; unbolt seven flanges; install blind flanges; remove pipe restraints, 2 snubbers; rig, lift, and store head spray line.
4. Scheduling Information: 8 hours
   (H) 6 hours
   (QC) 4 hours
   (F) 9 hours
   (BF) 18 hours
5. Manpower
   a. Special Skills: None
   b. Prefabrication: None
   c. Performance:
      1 qualified rigger
      6 mechanics
      1 crane operator
      1 supervisor
      1 HP full time
   (H) 3 mechanics
      1 crane operator
      1 supervisor
      1 HP full time
   (F) 6 mechanics
      1 crane operator
      1 supervisor
   d. Recovery: None
6. Special Equipment/Tools: Blind flanges.
   (QC) Blind flanges. Flanges should be of better material (ply wood used). Tape should be used also along with "C" clamps.
   (F) Blind flanges. Slugging wrenches, liquid wrench
   (BF) Blind flanges. Should provide additional sockets with longer extension.
7. Material (spare parts, special consumables, etc.): None
8. Prerequisites:
   1. Reactor head vented and vacuum maintained.
   2. Reactor at zero pressure, at or above minimum temperature but less than 200°F.
   3. Mechanical tool kit.
   4. C-clamps.
   (F) 1. Reactor head vented and vacuum maintained
   2. Reactor at zero pressure, at or above minimum temperature but less than 200°F.
   3. Mechanical tool kit.
   4. Vacuum ventilate if possible.
9. Procedures: MM1-1.

10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 50 mrem/hr
    (H) 5 mrem/hr
12. Total MAN-REM: 8 men x 50 mrem/hr x 6 hrs. = 2.4 MAN-REM
    (F) 8 men x 50 mrem/hr x 2 hrs. = .8
13. Personnel Protection: 2 sets of Anti-C and possibly full face mask.
14. Remarks:
    (H) MSIV testing and stuck MSRV's (two) interfering with vacuum ventilation. Job delayed in order to establish means to ventilate the Rx head thru the head vent system. Also delayed further to allow adequate ventilation time.
    Began to establish vent _____
    Vent established at 0045
    Cont. to Remove Head Pipe: 0125
    It is noted that during the ventilation period, the equipment pool could be made ready to receive the dryer and Sep. (i.e., cattle chote removed, miscellaneous equipment removed, etc.)
    Consideration should be given to unbolting head piping flanges and remove piping and insulation as one assembly.
    (BF) Workers need special tool to reach nut on underside of flange. They find it extremely difficult to reach it by hand.

ACTIVITY SERVICE PLAN
RF-7

1. Activity Title: Remove Head Insulation.
2. Location: Inside reactor well and on refueling floor.
3. Work Description: Unbolt (if applicable), install strongback, uncouple thermocouples, disconnect vent ducting, lift and store package, reconnect thermocouples.
   (H) Unbolt (if applicable), no strongback, uncouple thermocouples, disconnect vent ducting, lift and store package, reconnect thermocouples.
   (QC) Install strongback, uncouple thermocouples, lift and store package, reconnect thermocouples.
4. Scheduling Information: 2 hours.
   (F) 5 hours
   (BF) 1 hour
5. Manpower
   a. Special Skills: None
   b. Prefabrication: None
   c. Performance
      1 qualified rigger
      4 mechanics
      1 crane operator
      1 supervisor
      2 instrument mechanics
      1 HP (part time)
   (H) 1 qualified rigger
      3 mechanics
      1 crane operator
      1 supervisor
      2 instrument mechanics (regular mechanic removed thermocouples)
      1 HP (part time)
   (QC) 1 qualified rigger
      4 mechanics
      1 crane operator
      1 supervisor
      1 HP (part time)
   (F) 1 qualified rigger
      4 mechanics
      1 crane operator
      1 supervisor
      1 instrument mechanic
      1 HP (part time)
   (BF) 1 qualified rigger
      4 mechanics
      1 crane operator
      1 supervisor
      2 instrument mechanics
      1 HP (part time)
   d. Recovery: None

6. Special Equipment/Tools: Head strongback (or slings if used instead of strongback.)
   - (H) Slings used
   - (F) Head strongback
   - (BF) No Comment
7. Material (spare parts, special consumables, etc.): None
8. Prerequisites: Head vent spray piping disconnected.
   - (H) Head vent spray piping disconnected. May be left on head insulation.
   - (F) Head vent spray piping disconnected. Head thermocouples disconnected. Interfering pipe support removed.
9. Procedures: MMI-1
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 50 mrem/hr
    - (H) <1 mr/hr
    - (QC) 5 mrem/hr
    - (F) 1 mrem/hr
12. Total MAN-REM: 6 men x 2 hrs. x 50 mrem/hr - 0.6 MAN-REM.
    - (QC) N/A
13. Personnel Protection: 2 sets Anti-C clothing and possibly a full face mask.
    - (H) 2 sets Anti-C clothing.
    - (F) 1 set Anti-C clothing and possibly a full face mask.
14. Remarks:
    - (H) Began unbolting 0245. Insulation Removed and transfer to R/F Floor: 0425. Originally, the crane could not lift the head insulation high enough to clear equipment on R/F floor. Had to set down and adjust rigging. (See picture.)
    - (QC) Connection to vacuum ventilation rig interfered with insulation package removal - minor problem.
    - (F) Lifting would have been completed in less than an hour, but crane was used to reset drywell head and access to reactor building was not permitted because of leak rate test being conducted (2-1/2 hrs).
    - (BF) Additional work was required. 4 open man hole covers needed to be seated. This was done by taping polyethylene covers over openings. This work was required since blowers were used to cool down the drywell.

ACTIVITY SERVICE PLAN
RF-8

1. Activity Title: Install Carousel and Stud Tensioner
   - (H) Install spider and stud tensioner.
   - (F) Install spider and Stud tensioner
2. Location: Refueling floor - reactor well atop RPV head.
3. Work Description: Rig, lift, and position carousel in place.
   - (H) Rig, lift, and position in place.
   - (F) Rig, lift, and position carousel in place. (FitzPatrick tensioner. Use frame that hangs on the crane.
4. Scheduling Information: 2 hours.
   - (H) 10 minutes
   - (F) 30 min. (no GAME)
   - (BF) 1 hour.
5. Manpower
   - a. Special Skills: None
   - b. Prefabrication: 1 hour preparation requires two machinists.
     - (F) NA
   - c. Performance:
     - 1 qualified rigger
     - 5 mechanics
     - 1 crane operator
     - 1 supervisor
     - (QC) 1 qualified rigger
     - 5 mechanics
     - 1 crane operator
     - 1 supervisor
     - (8 on, 4 off)
     - (F) 2 mechanics
     - 1 crane operator
     - 1 supervisor
   - d. Recovery: None
6. Special Equipment/Tools - Four matched chokers.
   - (QC) NA
   - (F) Part of assembly since tensioners hang off crane at times during tensioning operation.
7. Material (spare parts, special consumables, etc.): Makeup oil available.
8. Prerequisites:
   1. Calibrated pressure gauge installed.
   2. Head insulation removed.

   (F)
   1. Did not have calibrated pressure gage when ready to start de-tensioning.
   2. Tensioner was installed 1 hour before end of shift and crew didn't want to start. Left work for other shift. 3 shifts which overlap would have eliminated unnecessary delays.
9. Procedures: MMI-1
10. Periodicity: Twice each refueling outage.

11. Estimated work area radiation field - 50 mrem/hr
    (QC) 10 mrem/hr general; only 45 at head seal contact
    (F) <5 mrem
    (BF) 8 mrem/hr
12. Total MAN-REM: 1 hr. x 5 men x 50 mrem/hr. = 0.25 MAN-REM.
    (F) 0
13. Personnel Protection: 2 sets Anti-C clothing and possibly full face mask.
14. Remarks:
    (H) Delayed start of this job for installation of D/W flange protector. In addition, R/F floor supervisor was not familiar with detensioning procedure or equipment and manuals were not available for reference. Tensioners installed and ready to go 0600. Carousel free's up crane.
    (QC) Vent hose from head vent
    Carousel track welds (2) cause interference
    Keep crane tension
    Has been reinforced
    Use better drive
    (BF) Carousel and stud tensioners moved as a unit.

ACTIVITY SERVICE PLAN
RF-9

1. Activity Title: Detension Studs
2. Location: Reactor well.
3. Work Description: Sequentially detension studs by pressure sequence.
4. Scheduling Information: 20 hours (based on Brown's Ferry's 92 studs) and four tensioners.
   - (H) 8-1/2 hours (based on Browns Ferry's 92 studs) and four tensioners. 52 studs.
   - (QC) 10 hours (based on Browns Ferry's 92 studs) (92 studs, QC) and four tensioners.
   - (F) 25 hours, 52 studs, and four tensioners.
   - (BF) 17 hours (based on Browns Ferry's 92 studs) and four tensioners.
5. Manpower
   a. Special Skills: 20% experienced personnel.
      - (QC) 100% experienced personnel.
      - (F) 100% experienced personnel.

   b. Prefabrication: None.

   c. Performance:
      - 10 mechanics
        1 supervisor (experienced)
        1 quality control inspector (if necessary)
        1 engineer
        2 machinists
      - (H) 5 mechanics (one on control)
        1 supervisor (experienced)
        1 crane operator
      - (QC) 12 mechanics (8 on, 4 off)
        1 supervisor (experienced)
        1 quality control inspector (if necessary)
        1 engineer
        2 machinists
      - (F) 9 mechanics
        1 supervisor (experienced)
        1 quality control inspector (if necessary)
        1 part time engineer
        2 mech per tensioner, 1 on pump, day shift
        1 mech per tensioner, night shift
      - (BF) 6 boiler makers
        1 supervisor (experienced)
        2 quality control inspectors (if necessary)
        1 engineer
        2 machinists

   d. Recovery: None.
6. Special Equipment/Tools: Contact pyrometer.
   - (H) Contact pyrometer not used. Carousel (required crane full time)
   - (QC) Contact pyrometer. None used.
   - (F) Contact pyrometer. Used only to determine locations of removed instrumentation which was not oriented.
7. Material (spare parts, special consumables, etc.): Spare parts for tensioners.

8. Prerequisites:
   1. Calibrate pyrometer.
   (H) NA
   (QC) (NA)
   2. Flange and head metal temperature above the applicable minimum value.
   3. Establish communication with control room.
   4. Reactor coolant temperature less than 200F and 0 psig.
   (F) 5. Calibrate pump pres. gage
9. Procedures: MMI-1.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 50 mrem/hr.
   (H) 5 mrem/hr.
   (QC) 5 mrem/hr.
   (F) 5 mrem/hr.
   (BF) 25 mrem/hr (contact), 5 mrem/hr (General Work Area)
12. Total MAN-REM: 15 hrs. x 11 men x 50 mrem/hr. = 8.25 MAN-REM.
   (H) 15 hrs. x 4 men x 5 mrem/hr. = 8.25 MAN-REM.
13. Personnel Protection: 2 sets of Anti-C clothing and possibly full face masks.
   (F) Set of Anti-C clothing
14. Remarks: Elongation rods and dial indicators may be installed to aid in determining if tensioners are working properly.
   (H) Elongation rods were installed but not used and dial indicators were not installed. Bale handle on one rod sticking out on top of stud held up tensioner ∿ 1/16" causing alarm.
   (QC) Elongation rods and dial indicators may be installed to aid in determining if tensioners are working properly. Rotated crews - use one man per tensioner, 1/2 worked while 1/2 waited. Completed 1st pass at 1410. Stud remover ears bent. Stud hung up (1).
   (F) Elongation rods and dial indicators may be installed to aid in determining if tensioners are working properly. (Not done)
   1) Crew lost ∿ 3-1/2 hrs. when one tensioner locked hydraulically. They did not have a tensioner manual, nor were they familiar with how it worked. When tensioner piston is over-extended, it opens an air safety valve avoiding a build-up of air pre-sure.
   (BF) Elongation rods and dial indicators may be installed to aid in determining if tensioners are working properly.
   a) Binding problems with hydraulic tensioners
   b) Needed turbine oil for power unit (lost 1 hr)
      Should stock additional supply of oil before outage (approx. 1 gal)
   c) Hydraulic units should be carefully checked out before outage

ACTIVITY SERVICE PLAN
RF-10

1. Activity Title: Remove Carousel and stud tensioners.
   (H) Remove stud tensioners.
   (F) Remove stud tensioners. (No GAME)
2. Location: Reactor well and refueling floor.
3. Work Description: Rig, lift, and store carousel.
   (F) Spider requiring continuous crane support used.
4. Scheduling Information: 2 hours.
   (H) 15 minutes.
   (F) 5 minutes.
   (BF) 1 hour.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance:
      1 qualified rigger
      5 mechanics
      1 crane operator
      1 supervisor
      (F) 2 mechanics
      1 crane operator
      1 supervisor
   d. Recovery: None.
6. Special Equipment/Tools: 4 matched slings, 15 feet long.
   (H) 4 matched slings, 10 feet long.
   (F) None.
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites:
   1. Head studs detensioned
   2. Area for storage cleared.
9. Procedures: MMI-1.
10. Periodicity: Twice each refueling outage.
11. Estimated work area radiation field: 50 mrem/hr.
    (QC) 5 mrem/hr.
    (F) negligible
12. Total MAN-REM: 1 hr. x 5 men x 50 mrem/hr. = 0.25 MAN-REM.
    (F) 0
13. Personnel Protection: 2 sets Anti-C clothing and possibly full face masks.
14. Remarks:
    (QC) Carousel removedl intact - tensioners removed separately.

ACTIVITY SERVICE PLAN
RF-11

1. Activity Title: Remove and Lift Nuts and Washers, and install Stud Protectors.
   (F) Remove and Lift Nuts and Washers, and install Stud Protectors (No GAME)
2. Location: Reactor well and refueling floor.
3. Work Description: Lower nut rack, remove nuts and washers, install thread protectors, lift and store nuts and washers.
4. Scheduling Information: 10 hours. May be performed in parallel with detensioning.
   (H) 3-1/2 hours. May be performed in parallel with last step detensioning. Could have been but wasn't with head strongback installation.
   (QC) 6 hours. May be performed in parallel with detensioning and tensioner removal.
   (F) 1-1/2 hours. May be performed in parallel with detensioning.
   (BF) 7 hours. May be performed in parallel with detensioning.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance:
      2 qualified riggers
      6 mechanics
      1 crane operator
      1 supervisor
      (H) 3 mechanics
      1 crane operator
      1 supervisor
   d. Recovery: None.
6. Special Equipment/Tools: Nut rack, two air motors, nut spinners, 4-way slings, thread protectors, guide caps (three), air hoses.
   (H) Using 1 pneumatic, 1 hand crank
   (F) Nut rack, two air motors, nut spinners, 4-way slings, thread protectors, guide caps (three), air hoses. Started with 3, 2 broke, finished with 1.
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites: None.
9. Procedures: MMI-1.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 50 mrem/hr.
    (H) 5 mrem/hr.
    (QC) 5 mrem/hr.
12. Total MAN-REM: 7 men x 8 hrs. x 50 mrem/hr. = 2.8 MAN-REM.
13. Personnel Protection: 2 sets of Anti-C clothing and possibly full face masks.
    (H) 1 set of Anti-C clothing and possibly full face masks

14. Remarks: Performed in parallel with detensioning if manpower available.

(H) Performed in parallel with detensioning if manpower available. Lift as many as possible at one time. Using 1, started 1330 EST local (not Geo. pair) time, terminated 1700 EST local (not Geo. pair) time.

(QC) Performed in parallel with detensioning if manpower available. Thread protectors not tightened down.

(F) Performed in parallel with detensioning if manpower available. Carried by hand to racks which were on EP block ledge.

(BF) Performed in parallel with detensioning if manpower available. Could not be done in parallel with detensioning because crane is required to take the strain of carousel so it will not bind on the track.

ACTIVITY SERVICE PLAN
RF-12

1. Activity Title: Vacuum Ventilate Reactor Pressure Vessel Head
   (H) Vacuum Ventilate Reactor Pressure Vessel Head (No GAME)
2. Location: Reactor well atop reactor vessel head.
3. Work Description: Ventilate Reactor Pressure Vessel Head.
   (QC) Ventilate Reactor Pressure Vessel Head, install connection
   (F) Ventilate Reactor Pressure Vessel Head using equipment described in No. 6 below.
4. Scheduling Information: Minimum 2 hours. Can be done in parallel with nut removal and thread protector installation.
   (H) Minimum 2 hours. Can be done in parallel with nut removal and thread protector installation. VAC Ventilating began at 1200 pm Sat. Lost vacuum at 4.00 pm, water in Main Steam Lines - normal.
   (QC) Minimum 2 hours - continuous operation. Can be done in parallel with nut removal and thread protector installation. Parallel with Head detensioning.
   (F) Minimum 32 hours. Can be done in parallel with nut removal and thread protector installation.
   (BF) Minimum 2 hours (6 hrs plus). Can be done in parallel with nut removal and thread protector installation.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance:
   d. Recovery: None.
6. Special Equipment/Tools: None.
   (QC) Filter Fan rig.
   (F) Permanent system with hose connection to head; discharge to SBGTS.
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites:
   1. Blind flanges must be installed, one with gate valve.
   (H) 1. Blind flanges must be installed, one with gate valve. Didn't see. Used wooden flanges taped to nozzle.
   (QC) 1. Blind flanges must be installed.
   (F) 1. Blind flanges must be installed.
   2. Communications must be established to control room.
   3. SBGT must be operable.
   (F) 3. SBGT must be operable. Yes
   4. Recirculation pumps operating at 40% or as required by O/P.
   5. RWCU operating.
   6. Condenser vacuum maintained.
   (QC) (No)
9. Procedures: MMI-1.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 50 mrem/hr.
   (QC) 5 mrem/hr.

12. Total MAN-REM: None (exposure credited to other tasks).
    (F) 1/2 hr x 2 men x 50 = 0.05 MAN-REM for connecting hose
13. Personnel Protection: as required for other work in the area.
14. Remarks: Begin after detensioning to ensure head temperature control.
    (H) Should begin before HD spray removal and maintain while Primary Boundary is broken. Resumed Vac Vent. thru Head Vent Nozzle to R/F Vent. Sys. (0045 - 3/13)
    (QC) Begin before detensioning to drop H_2O temperature to 100°F as soon as possible.
    (F) Begin after detensioning to ensure head temperature control. Vacuum venting to Mn. Cond. might reduce time reqd. for this activity. A hose that rides with carousel - elephant trunk or hose under carousel would permit paralleling with detensioning.
    (BF) Begin after detensioning to ensure head temperature control. This was done with all 4 steam line MSIV's open. Recommend only one steam line be used. Less chance of foreign matter being deposited on all MSIV's.

ACTIVITY SERVICE PLAN
RF-13

1. Activity Title: Close and Seal Drywell Manways
2. Location: Reactor Well.
3. Work Description: Clean sealing surface, install O-rings, bolt down latch covers.
4. Scheduling Information: 1 hour - no controlling path time - worked in parallel with other operations per "Remarks".
   (F) 2 hours - no controlling path time - worked in parallel with other operations per "Remarks".
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance:
      2 mechanics
      1 supervisor part time
   d. Recovery: None.
6. Special Equipment/Tools: None.
7. Material (spare parts, special consumables, etc.): O-rings.
8. Prerequisites:
   1. See "Remarks".
   2. Thermocouples removed from head.
9. Procedures: N/A.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 50 mrem/hr.
12. Total MAN-REM: 3 men x 1 hr. x 50 mrem/hr. = 0.15 MAN-REM.
13. Personnel Protection: 2 sets of Anti-C clothing and possibly full face masks.
14. Remarks: Check for leaks on monitoring Drywell side when water level is first raised.

    In parallel with head insulation removal. Must be accomplished after head piping removal but before RPV head is lifted.

    (QC) Check for leaks on monitoring Drywell side when water level is first raised.

    In parallel with head insulation removal. Must be accomplished after head piping removal but before RPV head is lifted.

    O-rings not replaced - just greased

    (F) Check for leaks on monitoring Drywell side when water level is first raised.

    In parallel with head insulation removal. Must be accomplished after head piping removal but before RPV head is lifted.

    No mark-up available for D/W cooler fans, lost 1 hour.

    (BF) Check for leaks on monitoring Drywell side when water level is first raised.

    In parallel with head insulation removal. Must be accomplished after head piping removal but before RPV head is lifted.

    No time taken, done in parallel with other work. All new gaskets installed on manway hatches.

ACTIVITY SERVICE PLAN
RF-14

1. Activity Title: Transfer RPV Head to Laydown Area
2. Location: Reactor well, RPV head support stand.
3. Work Description: Attach and adjust strongback; rig, lift, and store head; and install flange protector.
4. Scheduling Information: 3 hours.
   (H) 5 hours.
   (F) 2-1/4 hours.
   (BF-2) 3 hours. Completed 0340 (9-17-77)
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance:
      1 qualified rigger
      4 mechanics
      1 crane operator
      1 supervisor
      1 HP full time
   (F) 5 mechanics
      1 crane operator
      1 supervisor
      1 HP full time only when breaking flange and after
      2 laydown area prep
   (BF-2) 1 qualified rigger
      4 mechanics
      1 crane operator
      1 supervisor
      2 HP full time
   d. Recovery: None.
   (H) Remove rigging.
6. Special Equipment/Tools: Flange protector, strongback.
   (F) Flange protector (these were placed under the insulation package, requiring an additional lift), strongback.
   (BF-1) Flange protector, strongback.
      a) Needed full face mask and air tank on R.F. and cavity. This was required during the time air borne cont. was sampled. Lifted RIV head 6" approx. to take sample.
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites:
   1. Water level must be below vessel flange.
   2. Permission from shift engineer.
   3. Head must be vented.
   4. O-ring set in pedestal before lifting head.
   (H) 4. O-ring set in pedestal before lifting head. No.
   (QC) 4. O-ring set in pedestal before lifting head. H.P. survey to clear for airborne. Head lay down at 1100 3/23/77
   (F) 4. Not done, not necessary, 3-point pedestal
   5. Strong back leveled.
9. Procedures: MMI-1.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 50 mrem/hr.
   (H) 5 mrem/hr.
   (QC) 10 mrem/hr.
   (F) 5 mrem/hr.

12. Total MAN-REM: 2 hrs. x 6 men x 50 mrem/hr. = 20.6 MAN-REM.
    (F) 2 hrs. x 6 men x 5 mrem/hr. = 20.6 MAN-REM.
13. Personnel Protection: 2 sets anti-C clothing in Reactor Well and one set on refueling floor.
    (H) 2 sets anti-C clothing in Reactor Well and one set on refueling floor, face mask.
    (F) 1 set anti-C clothing in Reactor Well and one set on refueling floor.
14. Remarks:
    (H) Air sample complete before lifting head. Began 17.30.
    (QC) 6 studs require removal because the head will hang up otherwise.
    (BF-1) a) Readjusted turnbuckle setting on strongback.
    b) Some interferences with strongback and RPV head (support leg on strongback not clearing top flange on head).
    (BF-2) a) Lifted RPV head approx. 6" - took airborne reading for iodine containmination (3 hrs).
    Interference with strongback and RPV head/also mechanics moved strongback turnbuckle adjustment.
    b) Lifted and stored RPV head on mounting blocks 15 min.

ACTIVITY SERVICE PLAN
RF-15

1. Activity Title: Remove Steam Dryer
2. Location: Refueling floor.
3. Work Description: Adjust and attach strongback, lift and store in equipment pool.
4. Scheduling Information: 2 hours.
   - (H) 1-1/4 hours.
   - (QC) 1 hour.
   - (F) 3-1/2 hours.
   - (BF) 3 hours.
5. Manpower
   - a. Special Skills: None.
   - b. Prefabrication: None.
   - c. Performance:
     - 4 mechanics
     - 1 rigger
     - 4 laborers (continuous manual spray)
     - 1 crane operator
     - 1 supervisor
     - 1 HP
     - (H) 3 mechanics
     - 2 laborers (continuous manual spray)
     - 1 crane operator
     - 1 supervisor
     - 1 HP
     - (QC) 3 mechanics
     - 1 rigger
     - 2 laborers (continuous manual spray)
     - 1 crane operator
     - 1 supervisor
     - 1 HP
     - (F) 7 mechanics
     - 1 rigger
     - 1 laborer (continuous manual spray)
     - 1 crane operator
     - 1 supervisor
     - 3 HP part time continuous after poll
     - mech. part time
     - 1 QC
     - 1 Tech adviser
   - d. Recovery: None.
6. Special Equipment/Tools: Strongback, 200 ft. of rope, air hoses, water hoses.
   - (H) Strongback, no ropes connected, air hoses, water hoses.
   - (QC) Strongback, airhoses, water hoses.
   - (F) Strongback, air hoses (late find) water hoses.
   - (BF) Strongback, 200 ft. of rope, air hoses, water hoses. Fitting missing.
7. Material (spare parts, special consumables, etc.): None.

8. Prerequisites:
    1. Strongback checked out.
    (F) 1. Strongback checked out - not done until just prior to lift
    2. Spray system operable.
    (F) 2. Spray system operable. Cavity - yes, eq. pool - no.
    3. Equipment storage pool cleared out and covers removed.
    (F) 3. Equipment storage pool cleared out.
    4. Service air for strongback latching available.
9. Procedures: MMI-10.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 100 mrem/hr.
    (H) 40-50 mrem/hr.
    (QC) 300 mrem/hr.
    (F) 160 mr at hand rail, 1000 mr at flange.
12. Total MAN-REM: 5 hrs x 5 men x 100 mrem/hr = 0.25 MAN-REM
13. Personnel Protection: Two sets of Anti-C clothing and possibly face mask for reactor well, one set for refueling floor.
    (F) 1 set of Anti-C clothing and possibly face mask for refueling floor after pull alarms activated and masks donned.
14. Remarks:
    (H) Jot start 0000, Job finish 0115
    (BF) Air fitting (1/2" x '" nipple) was needed. Lost time - 1 hr.

ACTIVITY SERVICE PLAN
RF-16

1. Activity Title: Remove Transfer Slot Studs
2. Location: Reactor well
3. Work Description: Rig and lower stud racks, install stud removal tool, remove studs, store studs in racks, remove and store racks
4. Scheduling Information: 2 hours; part in parallel with separator unlatching
   (H) 30 min.; not done
   (QC) 4 hours; before lifting RPV head
   (F) 2 hours; before lift RPV head
   (BF) 30-1/2 hours; part in parallel with separator unlatching
5. Manpower
   a. Special Skills: None
   b. Prefabrication: None
   c. Performance: 1 rigger
      3 mechanics
      1 crane operator
      1 supervisor
      (H) 2 mechanics
      1 crane operator
      1 supervisor
      (F) 1 rigger
      2 mechanics
      1 crane operator
      1 supervisor
   d. Recovery: None
6. Special Equipment/Tools: Stud removal tool, stud breaker wrench, stud storage rack
   (H) Stud removal tool, stud breaker wrench — not needed, stud storage rack
   (BF) Stud removal tool, stud breaker wrench, stud storage rack. See 14a.
7. Material (spare parts, special consumables, etc): None
   (F) None.
   - Not aware of any spares
   - There are no spare studs
   (BF) None. No comment.
8. Prerequisites: None
   (F) None. Only procedures.
   (BF) None. No comment.
9. Procedures: MMI-1
10. Periodicity: Once each refueling outage
11. Estimated work area radiation field: 80 mrem/hr
   (QC) 5 mr/hr
   (F) 40 mrem/hr

12. Total MAN-REM: 4 men x 2 hrs x 80 mrem/hr = 0.64 MAN-REM
    (QC) NA
    (F) 3 men x 2 hrs x 40 mrem/hr = 0.24 MAN-REM

13. Personnel Protection: 2 sets of Anti-C clothing and possibly full face mask
    (F) 1 set of Anti-C clothing and possibly 1/2 mask

14. Remarks:
    (H) Spring type lifting device used to unweight studs then they easily spun out. Tension was determined by ease of turning. No problems encountered.
    (QC) XXXXX spare pin should be available. Studs removed before lead was removed; partially in parallel with nut removal.
    (BF) a) This tool is seriously underrated. Constantly shearing drive pin + motor malfunctioned. This removal tool should be replaced with unit that can deliver a min of 50 ft-lbs torque.

ACTIVITY SERVICE PLAN
RF-17

1. Activity Title: Install Main Steam Plugs and Drain Steam Lines
   (F) Install Main Steam Plugs
2. Location: Reactor well and refueling floor
3. Work Description: Install main steam plugs and drain steam lines
   (F) Install main steam plugs
4. Scheduling Information: 4 hours - part in parallel with separator unlatching
   (H) 1-1/2 hr to install, no drains - part in parallel with separator unlatching
   (QC) 2 hours - part in parallel with separator unlatching
   (F) (4 hrs. exactly including separator unlatching) (one plug leaked which extended total time to 16-1/2 hrs)
   (BF) 5 hours - part in parallel with separator unlatching
5. Manpower
   a. Special Skills: None
   b. Prefabrication: None
   c. Performance: 1 rigger
      4 mechanics
      1 crane operator
      1 supervisor
   (F) 1 rigger
      5 mechanics
      1 crane operator
      1 supervisor
6. Special Equipment/Tools: Steam plugs, air regulators with hoses, vent lines with gate valve, steam line plug strongback, underwater lights
   (H) Steam plugs, air regulators with hoses, vent lines with gate valve, steam line plug strongback
   (QC) Steam plugs, air regulators with hoses, vent lines with gate valve, steam line plug strongback, underwater lights. Used 9-ton crane and chain fall to position.
   (F) Steam plugs, air regulators with hoses, vent lines with gate valve, steam line plug strongback, underwater lights. Note: did not use underwater lights until verification of unlatching. Would have helped sooner.
   (BF) Steam plugs, air regulators with hoses, vent lines with gate valve, steam line plug strongback, underwater lights.
      a) Need additional air lines.
7. Material (spare parts, special consumables, etc): None
   (F) None. No spare plug available — had to borrow one from nine mile.
   (BF) None. No comment.
8. Prerequisites: 1. Dryer must be removed.
   2. Water must be above steam line.
   (H) 1. Dryer must be removed.
      2. Water must be above steam line — (not done)
   (F) 1. Dryer must be removed.
      2. Water must be below steam line. Water was below steam lines because "D" inbd MSIV was disassembled.
   (BF) 1. Dryer must be removed.
      2. Water must be above steam line.
      No comment.

9. Procedures: MMI-10.
10. Periodicity: Once each refueling outage
11. Estimated work area radiation field: 80 mrem/hr
    (H) 2 mr/hr
    (QC) 30 mr/hr
12. Total MAN-REM: 5 men x 3 hrs x 80 mrem/hr = 1.2 MAN-REM
    (H) NA
13. Personnel Protection: 2 sets of Anti-C clothing and possibly full face masks
    (F) 1 set of Anti-C clothing and used charcoal masks
14. Remarks:
    1. A vent line should be established to prevent backpressure buildup.
    2. Steam Plugs may be easier to install from service platform than from flange.
    3. TV camera may be used to check sectioning.
    4. Chain fall may make positioning of plugs easier.
    5. Steam line draining to seat plugs should be coordinated with MSIV testing.

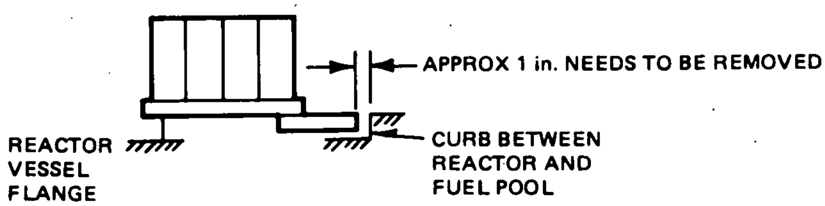
    (H)
    1. A vent line should be established to prevent backpressure buildup.
    2. Steam Plugs may be easier to install from service platform than from flange.
    3. TV camera may be used to check sectioning.
    4. Chain fall may make positioning of plugs easier.
    5. Steam line draining to seat plugs should be coordinated with MSIV testing. Not done. This installation done from flange using pole from opposite side to push in. Water level was below main steam lines.

    (QC)
    1. A vent line should be established to prevent backpressure buildup.
    2. Steam Plugs may be easier to install from service platform than from flange.
    3. TV camera may be used to check rating.
    4. NA
    5. Steam line draining to seat plugs should be coordinated with MSIV testing.

    (F)
    1. A vent line should be established to prevent backpressure buildup.
    2. Steam Plugs may be easier to install from service platform than from flange. - Not done.
    3. TV camera may be used to check sectioning. - Not done.
    4. Chain fall may make positioning of plugs easier. - Done for some plugs.
    5. Steam line draining to seat plugs should be coordinated with MSIV testing.
       A. Did not use service platform. Plugs and separator unlatching performed very easily from RPV flange.
       B. Did not drain steam lines to seat plugs.

ACTIVITY SERVICE PLAN
RF-18

1. Activity Title: Install Cattle Chute
2. Location: Reactor well, refueling floor
3. Work Description: Rig, lift, install cattle chute
4. Scheduling Information:
   1 hour. May be in parallel with separator unlatching.
   (H) 1 hour. Not done in parallel with separator unlatching.
   (F) 30 min. Was not done in parallel with separator unlatching.
   (BF) 1-1/2 hour. May be in parallel with separator unlatching.
5. Manpower
   a. Special Skills: None
   b. Prefabrication: None
   c. Performance: 1 rigger
      3 mechanics
      1 crane operator
      1 supervisor
      (F) 1 rigger
      2 mechanics
      1 crane operator
      1 supervisor
   d. Recovery: None
6. Special Equipment/Tools:
   Cattle chute lifting sligs, some plants use leveling blocks under chute.
   (H) Cattle chute lifting slings. Used special strong back.
   (F) Cattle chute lifting slings, some plants use leveling blocks under chute. Leveling blocks not used.
   (BF) Cattle chute lifting slings, some plants use leveling blocks under chute. (No blocks used.)
7. Material (spare parts, special consumables, etc): None
   (BF) None. N/C
8. Prerequisites: 1. Studs must be removed.
   2. Fuel pool gate shield block must be removed.
   (BF) 1. Studs must be removed.
   2. Fuel pool gate shield block must be removed. N/C
9. Procedures: N/A
10. Periodicity: Must be in place for fuel transfer.
11. Estimated work area radiation field:
    80 mrem/hr.
    (QC) 30 mr/hr
12. Total MAN-REM: 5 hrs x 4 men x 80 mrem/hr. - 0.16 MAN-REM.
13. Personnel Protection:
    2 sets of Anti-C clothing and possibly full face masks.
    (F) 1 set of Anti-C clothing and possibly charcoal masks



a) LENGTH OF CHUTE TOO LONG

14. Remarks

(H) Had to move cattle chute over the core

(F) What is weight of cattle chute? If less than 20 tons, they could have used aux. hook which is twice as fast.

(BF) a) Length of chute too long

ACTIVITY SERVICE PLAN
RF-19

1. Activity Title: Unlatch Moisture Separator
2. Location: Reactor well
3. Work Description: Unlatch moisture separator holddown bolts, adjust strongback turnbuckles, attach strongback to separator.
   (H) Unlatch moisture separator holddown bolts, adjust strongback turnbuckles, attach strongback to separator, verify latching.
   (QC) Unlatch moisture separator holddown bolts, attach strongback to separator.
4. Scheduling Information:
   8 hours
   (H) 6 hours
   (F) Unlatching in 2 hrs. Total job at least 8 hrs.
   (QC) 6 hours
   (BF) 3 hours
5. Manpower
   a. Special Skills: None
   b. Prefabrication: None
   c. Performance: 4 mechanics
      1 supervisor
      1 crane operator
   (F)
      Correct for Fitzpatrick
   d. Recovery: None
6. Special Equipment/Tools:
   Four shroud head T-bolt wrenches, strongback
   (F) Four shroud head T-bolt wrenches, strongback. Used only 2 wrenches. Unlatching time not greatly affected since biggest loss in time due to "frozen" bolts.
   (QC) One shroud head T-bolt wrenches, strongback.
   (BF) Four shroud head T-bolt wrenches, strongback. No comment.
7. Material (spare parts, special consumables, etc): None
   (BF) None. No comment.
8. Prerequisites:
   (H) 1. Service platform in reactor cavity
   (BF) No comment
9. Procedures: MMI-10.
10. Periodicity: Once each refueling outage
11. Estimated work area radiation field:
   60 mrem/hr
12. Total MAN-REM: 6 hrs. x 5 men x 60 mrem/hr = 1.8 MAN-REM
13. Personnel Protection:
   2 sets of Anti-C clothing and possibly full face mask.
   (F) 1 set of Anti-C clothing and possibly charcoal masks used.

14. Remarks:

Work may be easier from service platform than from flange.

(H) Work may be easier from service platform than from flange.
Began 0400 - Great difficulty in using unlatching wrench.
Must use hammer to force outer wrench down.
Completed and Verified Latching 0555.
Removed S/P 0600

(F)
1) Did not use service platform.
2) A few of the holddown bolts were stuck. Required banging to loosen.
3) Crew was not familiar with T-wrench operation. Took ≈20 min's for them to "get the hang of it."
4) Crew should have used underwater lights for de-latching. They didn't think of it until all the work was done.

(QC) Work may be easier from service platform than from flange.
Work done from the flange.

(BF) Work may be easier from service platform than from flange.
a) 7 of the separator hold down bolts not unlatched. This was realized after installing strongback. These bolts need to be inspected for unlatching to insure that no damage can occur to strongback/separator/or hoist.

ACTIVITY SERVICE PLAN
RF-20

1. Activity Title: Flood Cavity and Transfer Separator Underwater
(H) Flood Cavity and Transfer Separator Dry Transfer
2. Location: Refueling floor
3. Work Description: Flood reactor cavity, lift and store separator in equipment pool
4. Scheduling Information:
10 hours
(H) 2 hours
(QC) 5 hours
(F) 17-1/2 hours. (Actual flooding time about 5 hrs.)
(BF) 10 hours for flood, 6 hours for rigging.
5. Manpower
   a. Special Skills: None
   b. Prefabrication: None
   c. Performance: 1 rigger 1 HP (part time)
   4 mechanics
   1 crane operator
   1 supervisor
   (H) 1 rigger 1 HP (part time)
   4 mechanics
   1 crane operator
   (F) 2 mechanics
   1 crane operator
   1 supervisor
   d. Recovery: None
6. Special Equipment/Tools:
Underwater lights, 300 ft. of rope
(F) Underwater lights 150 ft, 2 lines
(BF) Underwater lights, 300 ft. of rope, separator strongback.
7. Material (spare parts, special consumables, etc): None
8. Prerequisites: 1. Inspect and clear reactor cavity and equipment pool
2. Steam line plugs are installed.
3. Water should be clear enough to observe the separator lift and transfer.
9. Procedures: MMI-10.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field:
Less than 5 mrem/hr
12. Total MAN-REM: 5 mrem/hr x 2 hrs. x 5 men = 0.5 MAN-REM
13. Personnel Protection: One set of Anti-C clothing
14. Remarks: 1. Water clarity prerequisites
2. Use feed system after condenser recirculating.
(H) 1. Separator transferred dry
2. R/F evacuated of nonessential personnel.

ACTIVITY SERVICE PLAN
RF-21

1. Activity Title: Cleanup Water
2. Location: Reactor well
3. Work Description: Purify water at maximum rate.
4. Scheduling Information:
   12 hours
   (QC) 8 hours
   (F) about 3 days
   (BF) 8 hours
5. Manpower
   a. Special Skills: None
   b. Prefabriction: None
   c. Performance: Plant operators
   d. Recovery: None
6. Special Equipment/Tools: None
7. Material (spare parts, special consumables, etc): None
8. Prerequisites: Reactor well flooded
   (QC) Cavity well (especially Bellows areas) must be cleaned
9. Procedures: BF-OI-69
10. Periodicity: BF-OI-69
11. Estimated work area radiation field: N/A
12. Total MAN-REM: N/A
13. Personnel Protection: N/A
14. Remarks: 1. Some clarity improvement has been achieved by recirculating feedwater continuously from the condenser through the feedwater demineralizers after shutdown until ready to flood up, and then filling through the feed by-pass line.
   (H) 1. Some clarity improvement has been achieved by recirculating feedwater continuously from the condenser through the feedwater demineralizers after shutdown until ready to flood up, and then filling through the feed by-pass line. (Not done)
   (QC) 1. Some clarity improvement has been achieved by recirculating feedwater continuously from the condenser through the feedwater demineralizers after shutdown until ready to flood up, and then filling through the feed by-pass line. (None this way - good clarity)
   (F) 1. Some clarity improvement has been achieved by recirculating feedwater continuously from the condenser through the feedwater demineralizers after shutdown until ready to flood up, and then filling through the feed by-pass line. Water from torus used. First pumped to hotwell then thru feed demin. This was thought to clarify but water was very dirty after flood up. 6/26 1015 to 6/29 1930

ACTIVITY SERVICE PLAN
RF-22

1. Activity Title: Unload Fuel
   (F) Unload Fuel - Full core load of 570 bundles
2. Location: Refueling floor and the refueling bridge
3. Work Description: Transfer fuel bundles to fuel pool, install blade guides and dunking chambers.
4. Scheduling Information:
   4 bundles per hour (average over entire operation including insertion of blade guides and dunking chambers).
   (H) 4 bundles per hour (average over entire operation including insertion of blade guides and dunking chambers). 186 hr. to unload entire core.
   (QC) 5 bundles per hour (average over entire operation including insertion of blade guides and dunking chambers). 33 min (cell during unrestricted movement).
   (F) 4 bundles per hour (average over entire operation including insertion of blade guides and dunking chambers).
   $\frac{570 \text{ bundles}}{396 \text{ hrs}}$ = 1.44 bundles per hr. if 95 hrs downtime for bridge maint is excluded
   $\frac{570}{301}$ = 1.9 bundles per hr. (4 bundles per hr. rate achieved on occasion.)
   Start 7/1/77 12:30 AM Complete 7/16/77 2400 hrs (est)
   (BF) 3.5 bundles per hour (average over entire operation including insertion of blade guides and dunking chambers). Total time 213 hrs (elapse time).
   Started unloading 0900 (9-20-77) Completed 0610 (9-29-77)
   Average unloading cycle time is approx. 30 min. per bundle.
   9-20-77 Averaging 5 bundles/hr over 3 hr period.
5. Manpower
   a. Special Skills: None
      (QC) RSO experienced operators - good dexterity, good depth perception - know equipment.
   b. Prefabrication: None
   c. Performance: 3 refueling bridge operators
      1 recorder (at board)
      (QC) 3 refueling bridge operators 1 Foreman
      1 recorder (at board) done by operator
      1 recorder/operator (licensed) in control room.
      (F) 2 refueling bridge operators
      1 recorder (at board)
      1 floor supervisor
      } each shift
   d. Recovery: None
6. Special Equipment/Tools:
   Blade guides, dunking chambers, binoculars, underwater camera.
   (H) Blade guides, dunking chambers, binoculars, underwater camera. Single blade guides used for about 1/2 cells?
   (QC) Blade guides, dunking chambers, binoculars, not required for unloading..
   (F) Blade guides, dunking chambers, binoculars, underwater camera, 2 ea. 1' x 1' x 4" viewing aids.

7. Material (spare parts, special consumables, etc): None
(H) None. Bridge spares - need sw's, TV camera, 2 independent means, 1 direct, 1 indirect (not gaitronics)
(QC) Pool tool accessories
(F) Refueling bridge spare parts.
8. Prerequisites: Water clarity, communication, bridge interlock circuitry, reactor control and rod control circuitry properly aligned per OI's.
(QC) Water clarity, communication, bridge interlock circuitry, reactor control and rod control circuitry properly aligned per OI's. Water extraction, except when Reactor Clamp Cooling System was shut down, thermal current were excessive making visibility poor.
9. Procedures: GOI-100-3
(F) GOI-100-3. Reactor Analyst Procedure 7.1.3 Surveillance Test 20F.
10. Periodicity: Each refueling outage.
11. Estimated work area radiation field:
Less than 5 mrem/hr.
(F) Less than 5 mrem/hr. 2-5 mr/hr gen'l area
12. Total MAN-REM: Insignificant
13. Personnel Protection:
1 set of Anti-C clothing
14. Remarks:
1. Reactor engineer provides step-by-step sequence for all fuel moves
2. Some plants suspend all drywell work during fuel transfers in case a fuel bundle is inadvertently dropped in the RPV between shroud and vessel wall, causing high radiation in the dry well.

(H)
1. Reactor engineer provides step-by-step sequence for all fuel moves.
2. Some plants suspend all drywell work during fuel transfers in case a fuel bundle is inadvertently dropped in the RPV between shroud and vessel wall, causing high radiation in the dry well. (Not done at hatch.)
3. One double blade guide caught on bundle channel fastener and was pulled out of the cell.

(QC)
1. Reactor engineer provides step-by-step sequence for all fuel moves.
2. Some plants suspend all drywell work during fuel transfers in case a fuel bundle is inadvertently dropped in the RPV between shroud and vessel wall, causing high radiation in the dry well. Work suspended above 2nd El. in D/W.

(F)
1. Reactor engineer provides step-by-step sequence for all fuel moves.
2. Some plants suspend all drywell work during fuel transfers in case a fuel bundle is inadvertently dropped in the RPV between shroud and vessel wall, causing high radiation in the dry well.
Drywell work conducted in parallel.
3. Lower tie plate drilling suspended to minimize fuel unloading time.

14. Remarks
(Cont'd) (BF)

1. Reactor engineer provides step-by-step sequence for all fuel moves.
2. Some plants suspend all drywell work during fuel transfers in case a fuel bundle is inadvertently dropped in the RPV between shroud and vessel wall, causing high radiation in the dry well.

#1 Unit - Elect. Solenoid for air valve that operates the grapple brake is malfunctioning. Unit 1 air will continually bleed out the exhaust. This occurs even through solenoid replaced and air valve replaced. Air supply will bleed down, causing difficulty.

Unit 1 -
Ross
Mod #233C93 460V 60∿

Unit 2 -
Hamafin
Mod CJ1-37
Temp. sticker reads 460V 60∿
Plate reads 115 VAC

9-22-77 Motor burned-up - replaced from another unit. Replacing cable (control) - electric wired wrong - 12 hr loss.

ACTIVITY SERVICE PLAN
RF-23

1. Activity Title: Fuel Sipping
(BF) Fuel Sipping (Not performed)
2. Location: Fuel pool
3. Work Description: Transfer fuel to sipping cans, sip fuel, return fuel to storage racks and analyze samples
4. Scheduling Information:
30 minutes/bundle (see remarks).
(H) 55 minutes/bundle (see remarks).
(45 recirc, 10 min. flush)
(QC) 30 minutes/bundle (see remarks). ∿3/hr or 22/shift.
Bundles marked in sequence of 5 at a time. Start 1, as soon as ready start sipping - sequence of 5 min. long.
(BF) 30 minutes/bundle (see remarks).
Actual elapse time ∿90 min. -
TI-25 requires 60 min. recirculation time. Balance is for transfer of bundle, sipping, etc.
(BF) 30 minutes/bundle (see remarks).
Best shift productivity 18 bundles in 12 hours using 2 cans (18 per day per can).
5. Manpower
a. Special Skills: None
b. Prefabrication: None
(H) 7 days to set up and check out gear
(QC) New sipping panel - checked out prior to use
c. Performance:

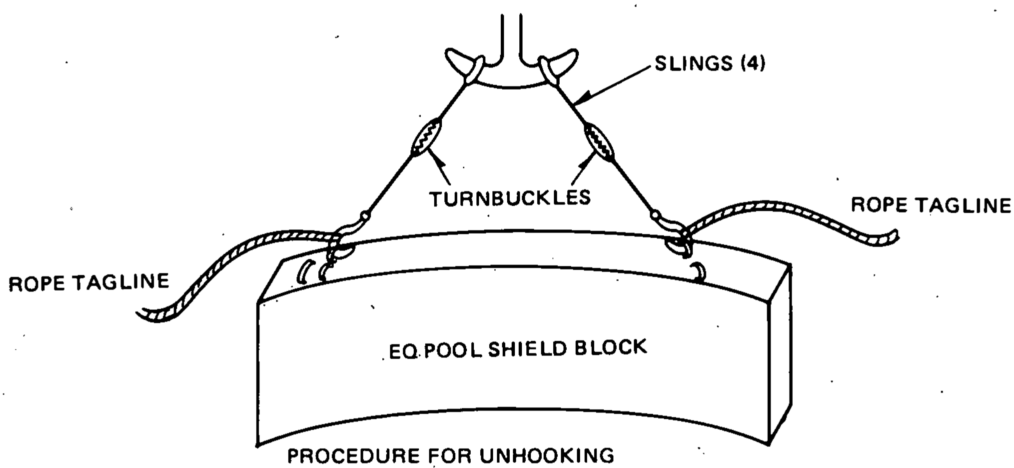
	2 bridge operators	2 sample transporters
	1 supervisor	2 chemical analysts
	1 panel operator	1 HP
	2 technicians	
(QC)	2 bridge operators	1 HP
	1 supervisor	
	1 panel operator	
(BF)	2 bridge operators (part time)	1 sample transporter
		1 chemical analyst
	1 supervisor	1 HP
	1 panel operator	
	1 technician	
(BF)	2 bridge operators	1 sample transporter
	1 supervisor	2 chemical analysts
	panel operator, technician } 1 man	1 HP (Part time)

d. Recovery: None
6. Special Equipment/Tools:
Fuel sipping equipment consisting of container stand; containers; recirculation, control, and sampling stations. Underwater lights, viewing aids and pool tool accessories, sample bottles.

7. Material (spare parts, special consumables, etc);
   Sample bottles and labels filter membranes, Liquid nitrogen, bottle carrier.
   (QC) Sample bottles and labels, bottle carrier.
8. Prerequisites: Preoperationally check sipping equipment.
9. Procedures: TI-25
10. Periodicity: Once each refueling outage as required by reactor engineer.
11. Estimated work area radiation field:
    5 mrem/hr. - (See Remarks)
    (H) <1 mrem/hr. - (See Remarks)
12. Total MAN-REM: 5 mrem/hr x 2 men x 7 days x 20 hrs. = 1.4 MAN-REM.
13. Personnel Protection:
    One set of Anti-C clothing
14. Remarks: Noncontrolling path is in-vessel work or inspections are being performed during the outage; otherwise, sequenced in with fuel transfers.
    11. General area, monitor sample bottles as soon as filled to determine radiation level.
    (H) Noncontrolling path is in-vessel work or inspections are being performed during the outage; otherwise, sequenced in with fuel transfers.
    11. General area, monitor sample bottles as soon as filled to determine radiation level.
    Rate of sipping was determined by rate of drilling.
    (QC) Controlling (because sipping 400 bundles) path is in-vessel work or inspections are being performed during the outage; otherwise, sequenced in with fuel transfers.
    11. General area, monitor sample bottles as soon as filled to determine radiation level. 5 to 15 mr/hr at 2".
    (Did 11 first shift, averaging about 22 a shift)
    (BF) Noncontrolling path is in-vessel work or inspections are being performed during the outage; otherwise, sequenced in with fuel transfers.
    11. General area, monitor sample bottles as soon as filled to determine radiation level.
    Actual crew - 1 panel operator
    1 sample transporter
    1 chemical analyst

ACTIVITY SERVICE PLAN
RF-24

1. Activity Title: Install Equipment Pool Shield Blocks
2. Location: Between RPV well and equipment pool
3. Work Description: Rig and install equipment pool shield plugs
   (BF) Browns Ferry 1 also uses a gate with an inflatable tube around it.
4. Scheduling Information:
   4 hours.
   (F) 4 hours. Rigging installed on first block on 7/13 and checked out in advance of move. (4 men ∿2 hrs) Performed 7/17/77 in about 1 hour.
   (H) 5 hours.
5. Manpower
   a. Special Skills: None
   b. Prefabrication: None
   c. Performance: 1 qualified rigger, 1 crane operator, 1 HP part time, 1 supervisor, 3 mechanics
      (BF) 1 qualified rigger, 1 crane operator, 1 HP part time, 1 supervisor, 5 mechanics
   d. Recovery: None
6. Special Equipment/Tools:
   30 ft. extension ladder, two matched slings.
   (F) 30 ft. extension ladder, two matched slings. Slings include turnbuckles for level adjustment. Slings removed from blocks manually with rope assist - no special tools.



PROCEDURE FOR UNHOOKING
1. LOWER CRANE HOOK. CREATE SLACK IN SLINGS
2. PULL HOOKS FROM LIFTING EYES USING ROPE TAGLINES (4 PLACES
3. USE ACTUATING POLE TO ASSIST IF NECESSARY

   (QC) 30 ft. extension ladder, 2-pt strong back.

7. Material (spare parts, special consumables, etc): None
8. Prerequisites: Reactor well and equipment pool drained to RPV flange level.
   (F) Reactor well and equipment pool drained to RPV flange level. This operation performed <u>wet</u>. Drainage not necessary.
9. Procedures: MMI-24
10. Periodicity: Once each refueling outage, twice if RPV internal work performed.
11. Estimated work area radiation field:
    200 mrem/hr.
    (H) 200 mrem/hr. (Good number at railing of E/D)
12. Total MAN-REM: 2 hrs x 4 men x 200 mrem/hr. = 1/6 MAN-REM.
    (F) 2 hrs x 4 men x 200 mrem/hr. = Negigible MAN-REM.
13. Personnel Protection:
    1 set of Anti-C clothing.
    (H) 1 set of Anti-C clothing, possible full face mask
14. Remarks:
    (F) Membrane around the pool shield blocks failed to seal. Equipment pool drained during subsequent reactor cavity draining operation. Result: up to 2R/hr around railing of eq. storage pool.

ACTIVITY SERVICE PLAN
RF-25

1. Activity Title:		Install Fuel Pool Shield Blocks
	(QC)	Install Fuel Pool Shield Blocks (No GAME)
	(F)	Install Fuel Pool Shield Blocks (No GAME)
2. Location:		Reactor well and refueling floor
3. Work Description:		Rig, lift, and set the fuel pool shield blocks.
4. Scheduling Information:		2 hours - work in parallel with fuel shuffling.
	(H)	1 hour - work in parallel with fuel shuffling.
	(QC)	1 hour - work in parallel with fuel shuffling.
	(F)	1 hour - work in parallel with fuel drilling.
	(BF)	2 hours - work in parallel with fuel shuffling. Installed fuel pool gates (2) in 20 min. in preparation to drain cavity for sparger work.
5. Manpower		
a. Special Skills:		None
b. Prefabrication:		None
c. Performance:		1 qualified rigger 3 mechanics 1 crane operator 1 supervisor
	(H)	3 mechanics 1 crane operator 1 supervisor
	(F)	4 mechanics 1 crane operator 1 supervisor
d. Recovery:		None
6. Special Equipment/Tools:		30 ft. extension ladder, four matched chokers
	(F)	30 ft extension ladder, one choker
7. Material (spare parts, special consumables, etc):		None
8. Prerequisites:		1. Fuel pool gates installed 2. Cavity drained (to below top of bottom block). 3. No fuel movement with 3 feet 0 inches of gates.
9. Procedures:		
10. Periodicity:		Twice each refueling outage--if work on internals is required.
11. Estimated work area radiation field:		60 mrem/hr.
	(QC)	30 mrem/hr.
12. Total MAN-REM:		1 hr x 2 men x 60 mrem/hr. = 0.12 MAN-REM.
13. Personnel Protection:		1 set of Anti-C clothing, 2 sets in Reactor well
	(F)	1 set of Anti-C clothing
14. Remarks		
	(F)	Procedure for this operation is good

ACTIVITY SERVICE PLAN
RF-26

1.	Activity Title:	Drain and Decontaminate Reactor Well
	(F)	Drain and Decontaminate Reactor Well (No GAME)
2.	Location:	Inside reactor well and on refueling floor.
3.	Work Description:	Drain and decontaminate
	(H)	Drain and decontaminate (RPV only)
4.	Scheduling Information:	16 hours (partially in parallel with separator installation if performed).
	(H)	24 hours (partially in parallel with separator installation if performed).
	(QC)	67 hours (not in parallel with anything).
	(F)	48 hours or more (partially in parallel with separator installation if performed).
	(BF)	(64 hours elapse time) (8 hours elapse time) after 2nd draining and after fuel loading) Started 1600 Oct 31, 1977 0800 Oct. 6, 1977
5.	Manpower	
	a. Special Skills:	None
	b. Prefabrication:	None
	c. Performance:	6 mechanics 1 supervisor 1 HP 1 crane operator
	(H)	4 mechanics 1 supervisor 1 HP 1 crane operator per cycle of 1-1/2 hrs
	(F)	6 mechanics 1 supervisor 1 HP 1 crane operator (Hydrolaser operation alone utilized 8 personnel. During setup there were 15 to 20 people on hand.)
	d. Recovery:	None
6.	Special Equipment/Tools:	High-pressure cleaner
	(QC)	900 lb pressure gain and $N_{93}PO_4$ w/scrub brushes
	(F)	High pressure cleaner. Hydrolayer
7.	Material (spare parts, special consumables, etc):	None
8.	Prerequisites:	1. Fuel pool gates installed
	(H)	1. Fuel pool gates installed 2. Equipment pool shield blocks installed
	(F)	1. Fuel pool gates installed. Sump pumps to remove water leaking from eq. storage pool.
9.	Procedures:	Per O/P's
10.	Periodicity:	Once each outage--twice if vessel internal work is required

11. Estimated work area radiation field:

		60 mrem/hr.
	(H)	400 mrem/hr.
	(BF)	110 mrem/hr.
12. Total MAN-REM:		60 mrem/hr. x 12 hrs. x 7 men = 1.54 MAN-REM
13. Personnel Protection:		One set of Anti-C clothing, plastic suit and face mask
14. Remarks:		1. At least bottom two equipment pool blocks installed before decontaminating. 2. Final drain may be in parallel with separator installation--water level must be maintained above separator.
	(F)	1. At least bottom two equipment pool blocks installed before decontaminating. 2. Final drain may be in parallel with separator installation--water level must be maintained above separator. Encountered paint chipping. Equipment pool seal leakage delayed drain, due to higher than planned volume. Labor dispute relative to crane operation delayed operation several hours. Airborne activity in cavity requires double charcoal mark.
	(BF)	1. At least bottom two equipment pool blocks installed before decontaminating. 2. Final drain may be in parallel with separator installation--water level must be maintained above separator. Before Hydro-Lasing = 5 x 10^6 D/M per 100 sq. cm. After Hydro-Lasing = 1.2 x 10^6 D/M per 100 sq. cm.

ACTIVITY SERVICE PLAN
RF-27

1.	Activity Title:	Install Service Platform
	(H)	Install Service Platform (No GAME)
	(F)	Install Service Platform (No GAME)
	(QC)	Install Service Platform (No GAME)
	(BF)	Install Service Platform (Not Observed)
2.	Location:	Reactor well
3.	Work Description:	Assemble and install track; rig and install operationally check service platform
4.	Scheduling Information:	1 hour
	(H)	1/2 hour
	(F)	45 mins.
5.	Manpower	
	a. Special Skills:	None
	b. Prefabrication:	1 supervisor 3 mechanics 1 rigger
	c. Performance:	4 mechanics 1 supervisor 1 rigger 1 HP part time 1 crane operator
	d. Recovery:	None
6.	Special Equipment/Tools:	Platform--special lifting sling (three-way). Track--Four 15-foot matched chokers. See note.
7.	Material (spare parts, special consumables, etc):	None
8.	Prerequisites:	Water level below RPV flange
9.	Procedures:	MMI-10
10.	Periodicity:	Once each refueling outage as required for reactor cavity work.
11.	Estimated work area radiation field:	20 mrem/hr.
12.	Total MAN-REM:	-0.5 hrs. x 6 men x 20 mrem/hr = 0.06 MAN-REM
13.	Personnel Protection:	1. Fuel pool shield blocks installed if fuel movements to be performed near fuel pool gate. 2. Equipment pool lower two shield blocks it 3. 2 sets of Anti-C clothing.
	(F)	1. Fuel pool shield blocks not installed. 2. Equipment pool lower two shield blocks all installed.
14.	Remarks:	
	(H)	1. Track is attached to platform and installed simultaneously with platform 2. Flange protector had to be removed before platform track is set
	(F)	3 out of 4 mechanics contaminated hands from removing gloves.
	(BF)	Not observed.

ACTIVITY SERVICE PLAN
RF-28

1.	Activity Title:	RPV ISI (Underwater)
	(BF)	RPV ISI (Underwater) (Fire Outage)
2.	Location:	Reactor well
3.	Work Description:	Visually inspect jet pumps, core spray system, cladding patches, and LPRM's (if required) for cracks, cracked welds, indication of movement, etc.
	(F)	Visually inspect jet pumps, core spray system, cracked welds, indication of movement, etc. LPRM's for breaks before R/repl., under lower support grid one cell.
4.	Scheduling Information:	30 hours.
	(H)	12 hours. (See below)
	(QC)	8 hours
	(F)	56 hours
5.	Manpower	
	a. Special Skills:	None
	b. Prefabrication:	None
	c. Performance:	1 qualified visual inspector 1 assistant 1 T.V. technician (on standby)
	d. Recovery:	None
6.	Special Equipment/Tools:	TV camera and TV screen, video tape machine, general-purpose underwater lights, acorn lights, pencil lights, viewing aid, binoculars.
	(H)	TV camera and TV screen, video tape machine, general-purpose underwater lights, acorn lights, pencil lights, viewing aid, binoculars. Check out wrenches and extensions for torque test.
7.	Material (spare parts, special consumables, etc):	Videotape
	(F)	Videotape, spare cameras of all types.
8.	Prerequisites:	1. Service platform installed. 2. Water clarity adequate and minimum turbulence.
	(QC)	1. Service platform installed - done from fuel bridge. 2. Water clarity adequate and minimum turbulence.
9.	Procedures:	Surveillance instruction (SI) 4.6.G, Attachment A
10.	Periodicity:	Once each refueling outage.
11.	Estimated work area radiation field:	20 mrem/hr.
	(QC)	5 mr/hr
12.	Total MAN-REM:	2 men x 26 hrs. x 20 mrem/hr. = 1.04 MAN-REM.
	(QC)	NA
13.	Personnel Protection:	2 sets of Anti-C clothing
	(QC)	1 set of Anti-C clothing
	(F)	1 set of Anti-C clothing, plastic pants, rubber gloves.

14. Remarks:

(H)	Jet Pump torque test	- 1 hr.
	J/P insp.	- 8 hrs.
	Core spray header	- 3 hrs.
	Core spray sparger	- not done
(F)	TV camera breakdown added 39 hours to job - total real time spent on underwater ISI = 95 hours	

ACTIVITY SERVICE PLAN
RF-29

1.	Activity Title:	RPV ISI (Not Underwater)
	(F)	RPV ISI (Not Underwater) (Not observed)
	(BF)	RPV ISI (Not Underwater) (Fire outage except visuals)
2.	Location:	Refueling floor and equipment storage pool
3.	Work Description:	1. Visually inspect steam dryer and moisture separator. 2. UT the required percent of RPV studs, nuts. 3. UT vessel to flange and head to flange welds (required percentages). 4. Visually inspect washers (and bushings whenever studs are removed). 5. UT required percentage of vessel flange ligaments.
	(QC)	1. Visually inspect steam dryer and moisture separator. 2. UT the required 100% of RPV studs, 100% nuts. 3. UT vessel to flange and head to flange welds (required percentages). 4. Visually inspect washers (and bushings whenever studs are removed). 5. UT required percentage of vessel flange ligaments.
4.	Scheduling Information:	20 hours (not controlling path)
	(H)	20 hours
5.	Manpower	
	a. Special Skills:	None
	b. Prefabrication:	None
	c. Performance:	1 quality control inspector (utility representative) 2 visual inspectors (2 hours) 4 UT inspectors (8 hours) 1 supervisor
	d. Recovery:	None
6.	Special Equipment/Tools:	1. UT equipment with recorders, binoculars. 2. Stud tension test equipment.
	(QC)	1. UT equipment with binoculars. 2. None.
7.	Material (spare parts, special consumables, etc):	None
8.	Prerequisites:	1. Removal of equipment from cavity 2. UT equipment calibrated
9.	Procedures:	Surveillance Instruction 4.6.G, Attachment A
10.	Periodicity:	As required to meet plant Technical Specifications
11.	Estimated work area radiation field:	20 mrem/hr.
	(QC)	5 mr/hr
12.	Total MAN-REM:	20 hrs. x 4 men x 20 mrem/hr. = 0.16 MAN-REM.
13.	Personnel Protection:	2 sets of Anti-C clothing.
	(QC)	1 set of Anti-C clothing.

14. Remarks:

1. UT of RPV flange ligaments performed in parallel with RPV underwater ISI, or other in-vessel work (spargers, LPRM's, etc.)

(H)

1. UT of RPV flange ligaments performed in parallel with RPV underwater ISI, or other in-vessel work (spargers, LPRM's, etc.)
Done on day shift with no interference with other work.

(BF)

1. UT of RPV flange ligaments performed in parallel with RPV underwater ISI, or other in-vessel work (spargers, LPRM's, etc.)
This activity was accomplished during Fire Outage. Normal visual inspection was made during this outage with no abnormal conditions noted.

ACTIVITY SERVICE PLAN
RF-30

1. Activity Title: Jet Pump Plug Installation
   (F) Jet Pump Plug Installation (no GAME)
   (BF) Jet Pump Plug Installation (Not done)
2. Location: Prefer installation from the vessel service platform; however, task may be performed from the refueling bridge.
   (QC) Prefer installation from the vessel service platform; however, task may be performed from the used bridge.
   (F) Prefer installation from the vessel; however, task may be performed from the refueling bridge.
3. Work Description: Install jet pump plugs (one loop).
4. Scheduling Information: 4 - 10 hours depending on where the work is performed.
   (H) 1 hr for 1 loop using service platform.
   (QC) 32 hours depending on where the work is performed.
   (F) 2 hours depending on where the work is performed.
5. Manpower
   a. Special Skills: 3 technicians with BWR underwater experience.
      (F) 3 technicians with BWR underwater experience. GE Techs.
   b. Prefabrication: None.
      (QC) 1 supervisor.
   c. Performance: 1 refueling bridge operator (if work is performed from the refueling bridge).
      (QC) (NA)
      (F) (NA)
   d. Recovery: None.
      (QC) Lead check plugs with air - reposition as required
      1 tester mechanics
6. Special Equipment/Tools: Plugs, actuating pole and socket, underwater lights.
   (F) Plugs, actuating pole and socket, underwater lights. Done during vib. inst. removal.
7. Material (spare parts, special consumables, etc) None.
8. Prerequisites: 1. Vibration instrumentation brackets may need to be removed.
   2. Service Platform installed.
   (QC) 1. Vibration instrumentation brackets may need to be removed.
   (F) 1. Vibration instrumentation brackets may need to be removed.
   2. Service Platform installed.
   Vibration brackets were removed first as a contingency to plugging jet pumps (good planning on part of GE)
9. Procedures: None.
10. Periodicity: As required for recirculation piping maintenance.

11. Estimated work area radiation field: 20 mrem/hr. service platform, 5 refueling floor and 5 mrem/hr refueling bridge.
    (QC) 5 refueling floor and 5 mrem/hr refueling bridge.
12. Total MAN-REM: 3 men x 20 mrem/hr. x 4 hrs = 2.4 per loop
13. Personnel Protection: 1 set Anti-C, one plastic suit.
    (QC) 1 set Anti-C
    (F) 1 set Anti-C, one plastic suit pants, rubber boots.
14. Remarks

ACTIVITY SERVICE PLAN
RF-31

1. Activity Title: Jet Pump Lug Removal
   (F) Jet Pump Plug Removal (no GAME)
   (BF) Jet Pump Plug Removal (Not done)
2. Location: Prefer removal of plugs to be done from the vessel service platform. This task may be performed from the refueling bridge.
   (QC) Prefer removal of plugs to be done from the vessel service platform. This task was performed from the refueling bridge.
3. Work Description: Removal of jet pump plugs (one loop).
4. Scheduling Information: 2-8 hours depending upon where the work is performed.
   (H) 30 minutes to untangle the guide ropes. 2 hrs to remove 10 plugs.
   (QC) 13 hours depending upon where the work is performed.
   (F) 30 min depending upon where the work is performed.
5. Manpower
   a. Special Skills: 3 technicians with BWR underwater experience.
      (QC) 4 technicians with BWR underwater experience.
   b. Prefabrication: None.
      (H) None. 1 manipulating tool, 1 controlling the light and window, 1 working guide rope.
   c. Performance: 1 refueling bridge operator (if work is performed from the refueling bridge).
      (H) 1 refueling bridge operator (if work is performed from the refueling bridge). Man operating tool manipulated the refueling bridge.
      (QC) 1 refueling bridge operator part time (if work is performed from the refueling bridge).
      (F) 1 refueling bridge operator (if work is performed from the refueling bridge). Done from serv. platform.
   d. Recovery: None.
6. Special Equipment/Tools: Actuating pole and socket, underwater lights.
7. Material (spare parts, special consumables, etc): None.
8. Prerequisites: 1. Work on recirculation lines complete.
   2. Service platform installed.
   (H) 1. Work on recirculation lines complete.
   2. Service platform installed.
   Service platform not installed for this operation.
   (QC) 1. Work on recirculation lines complete.
9. Procedures: None.
10. Periodicity: As required.
11. Estimated work area radiation field: 20 mrem/hr service platform, 5 mr/hr - refueling floor and refueling bridge.
   (QC) 5 mr/hr - refueling floor and refueling bridge.
   (F) 40 mrem/hr service platform, 5 mr/hr - refueling floor and refueling bridge.

12. Total MAN-REM: 3 men x 2 hrs x 20 mrem/hr = 1.2 per loop.
    (H) 3 men x 2 hrs x 20 mrem /hr = 1.2 per loop. Refueling bridge <5 mr/hr pers.
13. Personnel Protection: 1 set of Anti-C clothing, one plastic suit.
    (QC) 1 set of Anti-C clothing.
14. Remarks
    (H) Four plugs were removed in less than 20 minutes. Then the RHR pump was turned on with suction taken from the user's line. This created two problems. First, the bubbles rising from the unplugged jet pumps make viewing difficult. Bubbles accumulated on the floating window making viewing difficult. The suction created on the plug made it difficult to remove plug even though the plugs were unscrewed.

ACTIVITY SERVICE PLAN
RF-32

1. Activity Title: Remove Service Platform
   (QC) Remove Service Platform (not installed).
   (F) Remove Service Platform (No GAME)
2. Location: Reactor well and refueling floor.
3. Work Description: Rig to lift and store service platform.
4. Scheduling Information: 1 hour.
   (F) 30 min.
   (BF) 30 min.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 1 crane operator, 1 rigger, 4 mechanics, 1 HP, 1 supervisor
      (H) 1 crane operator, 2 mechanics, 1 HP, 1 supervisor
      (F) 1 crane operator, 4 mechanics, 1 supervisor
   d. Recovery: None.
6. Special Equipment/Tools: Special lifting sling (three-way).
   (H) Special lifting sling (three-way). Makeshift 4-way sling used - with wire sling doubled to extend 1 leg.
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites: Laydown space cleared.
9. Procedures: MMI-10.
10. Periodicity: Once each refueling outage as required for reactor cavity work.
11. Estimated work area radiation field: 20 mrem/hr.
12. Total MAN-REM: 5 men x 5 hrs. x 20 mrem/hr. = 0.05 MAN-REM.
13. Personnel Protection:
    1. Fuel pool shield blocks installed if fuel movements to be performed near fuel pool gate.
    2. Equipment pool lower two shield blocks installed.
    3. Two sets of Anti-C clothing.
14. Remarks

ACTIVITY SERVICE PLAN
RF-33

1. Activity Title: Remove and Replace LRPM's.
2. Location: Refueling bridge and refueling floor.
   (QC) Refueling bridge and refueling floor underneath the Rx vessel
   (F) Drywell under vessel.
3. Work Description: Remove LPRM, bend and store in fuel pool, attach to strongback and position replacement LPRM in reactor well, transfer weight of LPRM to instrument handling tool, place LPRM in proper position and verify latching with TV camera.
   (QC) Disassemble below the vessel seal, remove LPRM, bend and store in fuel pool, attach to strongback and position replacement LPRM in reactor well, transfer weight of LPRM to instrument handling tool, place LPRM in proper position and reassemble latching nut on seal.
   (F) Remove spent LPRM, bend and store in fuel pool. Attach new LPRM to strongback and position replacement LPRM in reactor cavity, transfer weight of LPRM to instrument handling tool, place LPRM in proper position and verify latching with TV camera.
   (F) Disconnect LPRM cables. Remove sleeve, seal and nut from LPRM RAC.
4. Scheduling Information: 1 LPRM/2 hrs.
   (H) 1 LPRM/hr. Best time R/R in 18 min.
   (QC) 1 LPRM/1 hr - 5 LPRM removed and replaced/shift.
   (F) 1 LPRM/2 hrs. Approx. correct after work started.
   (F) Elapse Time ~ 54 hrs for 32 LPRMs (60 hrs critical path productive time, ~38 hrs for 32 LPRM. 16 hrs unproductive time.
   1 LPRM/hr. Best time R/R in 28 min.

	Estimates
Inexperienced personnel	4 hrs
Inefficient crew changes	4
Poor water clarity	2
Bridge hoist limit switch repair	2
LPRM removal tool malfunction	2
Stuck LPRM	1
Others	1
	16 hrs

   (BF) 49 Total hours (elapse time). (Averaged 1 LPRM removal and replaced per hour)
5. Manpower
   a. Special Skills: none.

      (F) None. Experience would be helpful.
      (F) Experienced mechanical pipefitter and C&I technician.
   b. Prefabrication: none.
      (F) Drain pipe tunnels, hand operable ball valves 1-in. rigid tubing drain lines.

5. Manpower (continued)
   c. Performance: 2 technicians qualified for this process
   1 HP 1 crane operator
   1 refueling bridge operator
   2 mechanics
   (QC) 2 technicians qualified for this process
   1 HP 1 crane operator replacement
   1 refueling bridge operator
   2 mechanics - below vessel
   (F) 2 technicians qualified for this process. Need 5 or 6 to load LPRM into strongback
   1 HP 1 crane operator
   1 refueling bridge operator at least, 1 to operator bridge controls, 1 for communication and record keeping
   2 mechanics. 2 at least - below vessel to connect and work items there.
   (F) 2 technicians qualified for this process
   1 HP 5 Aux. operators to lead 1 crane operator
   1 refueling bridge operator
   2 mechanics
   1 Pipefitter under vessel
   1 I&C test LPRMS under vessel
   Continuous 24 hrs per day coverage needed throughout activity.
   (F) Intermittent coverage, testing LPRM in groups. 1 technician I&C qualified for this process.
   Continuous coverage 24 hrs, 1 mechanic or operator to install piping and flush tube.
   (BF) 2 technicians qualified for this process
   1 HP 1 crane operator
   1 refueling bridge operator
   2 mechanics
   3 GE personnel
   3 TVA personnel
   d. Recovery
   (QC) Reconnect cable
   (F) Reinstall LPRM nut, seal, sleeve and cables.
6. Special Equipment/Tools: Instrument handling tool, LPRM strongback, binoculars, viewing aide, communication devices, J-hook, 15 ft. aluminum pole, underwater lights, TV camera, monitor, LPRM strongback sling.
   (QC) Instrument handling tool, LPRM strongback, binoculars, viewing aide, communication devices, J-hook, 15 ft. aluminum pole, underwater lights, TV camera, monitor, LPRM strongback sling, tools to remove locking nut and seal and one pipe with a valve.
   (F) Instrument handling tool, LPRM strongback, binoculars, viewing aide, communication devices, J-hook, 15 ft. aluminum pole, underwater lights, TV camera, monitor, LPRM strongback sling. Need enough aluminum pole to reach lower side of upper core plate, for manual seating of LPRM's, also need special tools for seating.
   (F) Instrument handling tool, LPRM strongback, 2 binoculars, 2 viewing aides, 2 communication devices, J-hook, 15 ft. aluminum pole, underwater lights, TV camera, monitor, LPRM strongback sling. Overhead crane safety catch plate and 2 ropes LPRM nose guides.

6. Special Equipment (continued)
   - (F) High resistance test meter, high voltage power supply, test cables. Deep LPRM nut socket to fit over 16" long tube nose guide. Deep LPRM nut seal spanner wrench 16" long over nose guide.
7. Material (spare parts, special consumables, etc.): none.
   - (QC) Teflon seals
   - (F) Enough 1/4" nylon rope to tie each LPRM to hand rail and let hot end lie on bottom of fuel pool. Need spare instrument handling tool and spare parts for repair of this tool. Need supply of clean lint free white rags and supply of recommended cleaning fluid, alcohol, or mineral spirits or equivalent.
   - (F) LPRM tie-off rope. Acetone cleaning fluid and swabs.
   - (F) New LPRM nut seals (Teflon), Teflon tape, Dow Corning thread lube, new cable connectors.
8. Prerequisites:
   1. Water clarity.
   2. Adjacent fuel bundles removed.
   3. Communications set up with drywell crew.
   4. Drywell disconnect work must be complete.
   5. Replacement LPRM's on site and inspected.

   (QC)
   1. Water clarity.
   2. Adjacent fuel bundles removed.
   3. Communications set up with drywell crew and control room.
   4. Drywell disconnect work must be complete - tip tubing removed for access.
   5. Replacement LPRM's on site and inspected.

   (F)
   1. Water clarity - must be clear enough to work at bottom.
   2. Adjacent fuel bundles removed. 4 empty holes surrounding each LPRM.
   3. Communications set up with drywell crew. 1 constant with 1 spare preferred.
   4. Drywell disconnect work must be complete. If not all - at least 5 ahead of removal pattern. All is preferred.
   5. Replacement LPRM's on site and inspected. All new LPRM's to be inspected and ready including any spares.

   (F)
   1. Water clarity. Must be clear, especially for inexperienced ops.
   2. Adjacent blade guides to clear inspection channel
   3. Communications set up with drywell crew and control room.
   4. Drywell disconnect work must be complete.
   5. Replacement LPRM's on site inspected and properly tagged approval for installation during receipt inspection. One LPRM was rejected for insufficient electrical resistance but was installed by mistake.because it had not been tagged by PASNY QE. This cost $\sim$ 2 hrs time.

   (F)
   1. Drywell disconnect work must be complete, i.e., open and remove sleeve.
   2. Disconnect cables just prior to LPRM removal only.
   3. Remove LPRM tube nut seal, nut and washer
   4. Install drain pipe funnel, ball valve and Tygon tubing and route to sump.

9. Procedures: GEK 33143
   (F) GEK 33143B
10. Periodicity: Each refueling outage based on operational requirements.
11. Estimated work area radiation field: less than 5 mrem/hr.
   (QC) Less than 5 mrem/hr. - 30 mr/hr for under vessel
   (F) 30-150 mr under vessel
   (F) 30 to 150 mrem/hrs
12. Total MAN-REM: insignificant
   (QC)
   (F) Significant under vessel
   (F) ∿300 - 500 mrem
13. Personnel Protection: 1 set of Anti-C clothing
   (F) 1 set of Anti-C clothing - any other required by particular situation.
14. Remarks: It may be advantageous to install the in-vessel rack to store fuel bundles removed in order to gain access to LPRM.
   (QC) It may be advantageous to install the in-vessel rack to store fuel bundles removed in order to gain access to LPRM or work in parallel with fuel unloading. Removed all before installing.
   (F) It may be advantageous to install the in-vessel rack to store fuel bundles removed in order to gain access to LPRM. In this case all fuel was removed; therefore the blade guides had to be placed in a particular pattern to allow LPRM accessibility.
   (F) It may be advantageous to install the in-vessel rack to store fuel bundles removed in order to gain access to LPRM. Yes, but all fuel was removed from core at this plant. Comments: Undervessel work, unlike refueling floor work should be covered on a Drywell ASP.
   (F) It may be advantageous to install the in-vessel rack to store fuel bundles removed in order to gain access to LPRM. Comments: Prerequisite (item 2) disconnect cables was performed prior to unloading fuel. Cables had to be reconnected to satisfy that 15% APRM trip is operational during fuel unloading. This cost 6 to 8 hrs delay in unloading fuel. LPRM latching was checked twice after all LPRM were installed. Once should be enough. If necessary this could be video taped for review. Several drip leakers under vessel were caused by installing Teflon seal ahead of nut washer rather than in nut.
   (BF) It may be advantageous to install the in-vessel rack to store fuel bundles removed in order to gain access to LPRM. Radiation field:
   1) white LPRM transversing tunnel (cattle chute) about 4 mrem/hr.
   2) Highest LPRM (top) 500 mrem/hr at contact.
   3) Three feet at rail highest 10 m/rem.

ACTIVITY SERVICE PLAN
RF-34

1. Activity Title: Remove Surveillance Samples from the Core.
2. Location: Reactor well
3. Work Description: Remove samples and store in fuel pool.
   (BF) Remove samples and store in fuel pool. Dosimeter type wire only.
4. Scheduling Information: 2 hours.
   (H) 30 min
   (QC) 2 hours. Not done, verified in place and intact.
   (F) 1 hour (not counting search).
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 3 technicians.
   d. Recovery: None.
6. Special Equipment/Tools: Actuating poles, video camera, underwater lights, J hook.
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites: 1. Vibration instrumentation may have to be removed.
   2. Service platform installed.
9. Procedures: None.
10. Periodicity: As specified in technical specifications.
11. Estimated work area radiation field: 20 mrem/hr. service platform.
    (F) 40 mrem/hr. service platform.
12. Total MAN-REM: 20 mrem/hr. x 2 hrs. x 3 men = 0.12 MAN-REM.
13. Personnel Protection: 2 sets of Anti-C clothing
14. Remarks
    (F) Night crew did not mnt. experienced personnel. Didn't look and verify flux wire was there first. Flux wire not found, dropped, lost 3 days looking.
    (BF) No "game" made up on this.

ACTIVITY SERVICE PLAN
RF-35

1. Activity Title: Inspect Sources
   (H) Remove Sources
   (QC) Inspect Sources, not done
   (F) Inspect Sources, not obs.
   (BF) Inspect Sources (7 sources removed)
2. Location: Reactor well
3. Work Description: Visually inspect sources and verify latching.
4. Scheduling Information: 2 hours. Performed with LPRM inspection.
   (H) 2 hours.
   (BF) 2 hours. Performed with LPRM inspection. 24 hours elapse time
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 2 technicians.
   d. Recovery: None.
6. Special Equipment/Tools: Underwater lights, video camera with right-angle lens.
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites: 1. Service platform installed.
   2. Water clarity is established.
9. Procedures: None.
10. Periodicity: Once per refueling outage.
11. Estimated work area radiation field: 20 mrem/hr. service platform.
12. Total MAN-REM: 2 men x 2 hrs. x 20 mrem/hr. = 0.08 MAN-REM.
13. Personnel Protection: 2 sets of Anti-C clothing.
14. Remarks

ACTIVITY SERVICE PLAN
RF-36

1. Activity Title: Reload Core
2. Location: Refueling floor and refueling bridge
   (F) Refueling floor, refueling bridge and control room
3. Work Description: Install fuel bundles, remove blade guides and dunking chambers.
   (H) good #
   (QC) Install fuel bundles, remove blade guides and dunking chambers. 50 bundles in one shift, 5.7/hr average, 8 hours.
   (F) Install fuel bundles, remove blade guides and dunking chambers, complete refueling prerequisite check list activities and surveillance tests. Perform subcriticality rod pull tests.
4. Scheduling Information: Four bundles/hour (average over entire operation including removing blade guides and dunking chambers).
   (F) 2 bundles/hour (average over entire operation, total time 11 days 17 hours, 560 bundles, including removing blade guides and dunking chambers).
   - SD margin checks
   - rearranged 13 incorrectly loaded bundles
   - Flux wire search ∿1 day cumulatively
   (F) Two bundles/hour (average over refueling operation, including subcriticality and weekly checks and removing blade guides and dunking chambers). Excludes prerequisite checks
   (BF) 2.67 bundles/hr (average over entire operation including removing blade guides and dunking chambers). 285.5 total hours. 11.9 days.
5. Manpower
   a. Special Skills: None.
      (F) One licensed operator with underwater-fuel handling experience
      One auxiliary operator with underwater-fuel handling experience
   b. Prefabrication: None.
      (F) Blade guide storage facilities. Two >6" deep viewing aids.
   c. Performance: 3 refueling bridge operators
      1 recorder (at board).
      (F) 2 refueling bridge operators
      1 recorder (at board).
      (F) 2 refueling bridge operators see above
      1 recorder (at board) with Quality Assurance Verification Authority
   d. Recovery: None.
6. Special Equipment/Tools: Binoculars and underwater camera

   (QC) Viewing aid, 2 1500 Watt lights hung in the cavity
   (F) Binoculars and underwater camera, refueling grapple and boom blade guide storage racks, dunking chambers.

7. Material (spare parts, special consumables, etc.): None.
   - (F) Large complement of electrical spares, solenoids, contacts, reed and proximity sw's connectors, position indication equipment
   - (F) Refueling bridge, boom and grapple spare parts
8. Prerequisites: Water clarity, communication, bridge interlock circuitry, reactor control and rod control circuitry properly aligned per GOI-100-3.
   - (F) Water clarity, communication, bridge interlock circuitry, reactor control and rod control circuitry properly aligned per GOI-100-3.
     Secondary Containment Test
     Fuel Movement checklist items not noted here
   - (F) Water clarity, communication, bridge interlock circuitry, reactor control and rod control circuitry properly aligned. Satisfactory completion of all Refueling Procedure No. 7.1.3 Refueling Checklist items.
9. Procedures: GOI-100-3.
   - (F) 7.1.3
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: Less than 5 mrem/hr.
12. Total MAN-REM: Insignificant
13. Personnel Protection: One set of Anti-C clothing
14. Remarks
    1. Reactor Engineer provides step-by-step sequence for all transfers.
    2. Browns Ferry suspends all drywell work during fuel transfers in case a fuel bundle is inadvertently dropped in the RPV between the shroud and vessel wall.
    3. Note reliability of refueling bridge.

    (QC)
    1. Reactor Engineer provides step-by-step sequence for all transfer
    2. Suspends all drywell work above 2nd levels during fuel transfers.
    3. Note reliability of refueling bridge. Lost 1 hr first day - grapple tangled in dunking chamber.

    Using BWRU for water cooling - avoid clouding Rx water with RHR

    (F)
    1. Reactor Engineer provides step-by-step sequence for all transfers.
    2. Fitzpatrick suspends all drywell work above 326' level during fuel transfers in case a fuel bundle is inadvertently dropped in the RPV between the shroud and vessel wall. Lower drywell activities continued.
    3. Note reliability of refueling bridge.
       One 300 Vac 3Ø power cable to bridge parted at the refueling floor junction box flex point. (A similar break occurred during unloading fuel.) A spare wire was used to continue bridge operations. The frequent refueling bridge use during the outage stopped major bridge preventive or corrective maintenance work. Thus, temporary repairs failed to provide the desired bridge reliability.
    4. Fuel grapple and boom reliability: air brake solenoid failure and excessive friction during extension and retraction.

14. Remarks: (continued)

(BF) 1. Reactor Engineer provides step-by-step sequence for all transfers.

2. Browns Ferry suspends all drywell work during fuel transfers in case a fuel bundle is inadvertently dropped in the RPV between the shroud and vessel wall.

3. Note reliability of refueling bridge.

It took three (3) additional hours to correct discrepancies found during the verification of the core.

ACTIVITY SERVICE PLAN
RF-37

1. Activity Title: Verify Core Loading
2. Location: On refueling bridge over reactor well.
3. Work Description: Inspect and record fuel location (using TV camera) and verify bundle seating by traversing grapple just above bales.
   (QC) Inspect and record fuel location (using TV camera), and verify bundle seating by camera traversing grapple just above bales.
4. Scheduling Information: 14 hours.
   (H) 5 hours.
   (QC) 19 hours.
   (F) 11 hours.
   (BF) 14 hours. 8-1/4 hrs to verify seating of bales and taking of video tape. 5 hrs to review and verify video tape (3 discrepancies, see GAME), 3 hrs to verify area that rework was done. 2-1/2 hours to again verify seating of core.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 1 refueling bridge operator
      1 reactor engineer
      1 quality control inspector
      1 instrument mechanic part time
   (QC) 2 refueling bridge operator
      1 reactor engineer
      3 quality control inspector
      3 instrument mechanic part time
      1 Tech. Staff
      1 Electrician
      3 "Auditors"
      2 fuel handlers (bridge operator)
   d. Recovery: None.
6. Special Equipment/Tools: TV camera, TV monitor, video recorder, binoculars.
   (QC) TV camera, TV monitor, video recorder, binoculars, hung on rope.
7. Material (spare parts, special consumables, etc.): Video tape available.
   (F) Video tape available. Spare camera should be checked out and ready.
8. Prerequisites: Core loaded.
   (F) Core loaded. Rods all inserted - start of this evaluation held up for shutdown margin check after core loading since it required stroking rods.
9. Procedures: GOI-100-3.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: Less than 5 mrem/hr.
12. Total MAN-REM: Insignificant.
13. Personnel Protection: One set of Anti-C clothing.
14. Remarks:
   (QC) Did a preliminary verification, 13 hrs, and checked camera and lights. Problems with refill bridge is 12 hours (5 hrs dduring verify) Total in sequence - start Preliminary Verify Repair bridge, final verify, ∿37 hrs.
   (F) This job run smoothly - camera problems experienced earlier in the outage were all ironed out by time this activity was started.

ACTIVITY SERVICE PLAN
RF-38

1. Activity Title: Functional/Friction Test CRD System
   (H) Functional/Friction Test CRD System (not observed)
2. Location: Control Room and Reactor Building
3. Work Description: Cycle and vent hydraulic control system, perform stroke timing and differential pressure measurement friction testing for all CRD's.
   (F) Cycle and vent hydraulic control system, perform stroke timing and differential pressure measurement friction testing for all CRD's and scram timing.
4. Scheduling Information: two days
   (QC) 21 hrs
   2 in control room
   5 on floor in Reactor Building
   (F) 39 hours (not including 11-hour start delay)
   (BF) 64 hrs (2.7 da) plus 4 hrs to vent plus 4 hrs to replace one (1) CRD that did not pass test. (185 CRD's)
5. Manpower
   a. Special Skills: None
   b. Prefabrication: None
   c. Performance: Two technicians familiar with test equipment. Plant operators
   d. Recovery: None
6. Special Equipment/Tools
   1. Storage Oscilloscope
   2. Amplifier Probes
   3. D/P Cells and Hose Attachments
   4. Polaroid Camera to fit Oscilloscope
   (QC) 1. (None)
   2. (None)
   3. D/P Cells and Hose Attachments
   4. Strip chart recorder
   (BF) 1. 2 Oscilloscopes used
   2. 2 sets
   3. D/P Cells and Hose Attachments, 2 D/P cells used
   4. Polaroid Camera to fit Oscilloscope. 2 cameras used
7. Material (spare parts, special consumables, etc.):
   1. Polaroid film
   2. Poly tubing for venting
   (QC) Not used, venting done later as prerequisite to timing.
   (BF) 1. Polaroid film
   2. Poly tubing for venting
   Spare oscilloscope not available
8. Prerequisites
   1. All fuel movements and other in-core work completed
   2. Normal water levels established
   3. Normal CRD flow established
9. Procedures: GEK 9582

10. Periodicity: Once each refueling outage
11. Estimated work area radiation field: less than 5 Mrem/hour
12. Total MAN-REM
13. Personnel Protection
    (F) One set Anti-C
14. Remarks
    (QC) This test is not a "requirement" but was done as good engineering practice on all rods.

ACTIVITY SERVICE PLAN
RF-39

1. Activity Title: Transfer Underwater and Install Moisture Separator
   (H) Transfer Dry and Install Moisture Separator
2. Location: Equipment pool, reactor well, and refueling floor.
3. Work Description: Install rigging, lift and install separator, remove strongback.
   (F) Install rigging, life and install separator, as cavity is drained, remove strongback.
4. Scheduling Information: 3 hours.
   (H) 2-1/2 hours.
   (QC) 6 hours.
   (F) 14-1/2 hours.
   (BF) 1) 2 hrs to position separator into position.
   2) 3 hrs to lower separator along with water level
   3) 3 hrs elapsed time to torque separator
   4) One (1) hr to break spring loose on locking devices.
5. Manpower
   a. Special Skills: None
   b. Prefabrication: None
   c. Performance: 1 qualified rigger, 1 supervisor, 4 mechanics, 1 HP part time, 1 crane operator
   (H) 4 mechanics, 1 supervisor, 1 crane operator, 1 HP part time
   (F) 2 mechanics, 1 supervisor, 1 crane operator, 1 RF supervisor (Engineer)
   d. Recovery: None.
6. Special Equipment/Tools: Underwater light, dryer/separator strongback, 300 ft rope.
   (H) Dryer/separator strongback Note: Transferred Dry
   (F) Underwater light, dryer/separator strongback, 100 ft. rope, 2 lines used
7. Material (spare parts, special consumables, etc.): None.
   (H)
8. Prerequisites: 1. Equipment plugs removed
   2. Fuel pool gates installed
   3. All in-vessel work (core shuffling and all inspection) complete.
   4. Reactor cavity flooded.
   (H) 1. Equipment plugs removed except the bottom plug
   2. Fuel pool gates installed.
   3. All in-vessel work (core shuffling and all inspection) complete.
   4. Transferred Dry.
9. Procedures: MMI-10.

10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: Less than 5 mrem/hr.
    (H) 50 mr/hr
12. Total MAN-REM: Insignificant
    (H) None
13. Personnel Protection: One set of Anti-C clothing.
14. Remarks: Drain and decon vavity after completion.
    (H) None
    (F) Drain cavity during lowering of ms keeping 3 or 4 feet under water. Decon cavity after completion.
    (BF) Drain and decon cavity after completion.
    a) 700 mrem/hr over separator while moving it and at its highest point
    b) 100 mrem/hr at the rail where separator was at its highest point
    c) Reduced to 2 mrem/hr when separator lowered under water

ACTIVITY SERVICE PLAN
RF-40

1. Activity Title: Remove Main Steam Line Plugs
2. Location: Inside reactor well and on refueling floor.
3. Work Description: Attach strongback, deflate, and remove steam line plugs.
4. Scheduling Information: 2 hours (if water is below main steam line nozzles).
   (H) 1 hour (if water is below main steam line nozzles).
   (QC) 1 hour (if water is below main steam line nozzles).
   (F) 7 hours (if water is below main steam line nozzles).
   (BF) 1 hour (if water is below main steam line nozzles).
   (Preparation time was also 1 hour - elapsed time 2 hours.)
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 1 rigger 1 supervisor
      1 crane operator 1 HP
      4 mechanics
      (H) 1 rigger 1 supervisor
      1 crane operator 1 HP (part time)
      2 mechanics
      (F) 1 crane operator 1 supervisor
      2 mechanics
   d. Recovery: 1 hour - 2 mechanics, 1 supervisor
6. Special Equipment/Tools: Steam line plug strongback.
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites: 1. MSIV work completed.
   2. Main steam valve lineup per standard operating procedures.
   3. Main steam Relief valve work completed.
   (H) 1. MSIV work completed.
   2. Main steam valve lineup per standard operating procedures.
   3. Main steam Relief valve work completed. Blind flanges installed.
   (F) 1. MSIV work completed.
   2. Main steam valve lineup per standard operating procedures.
   3. Main steam Relief valve work completed.
   4. Moisture separator installed.
9. Procedures: MMI-10.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 60 mrem/hr.
    (QC) 30 mrem/hr.
12. Total MAN-REM: 2 hrs. x 5 men x 60 mrem/hr. = 0.6 MAN-REM.
13. Personnel Protection: 2 sets of Anti-C clothing.
14. Remarks: If reactor water level is above main steam line nozzles, time for removal will increase; and completion of inboard MSIV work is mandatory.
    (QC) If reactor water level is above main steam line nozzles, time for removal will increase; and completion of inboard MSIV work is mandatory. Level below.
    (F) If reactor water level is above main steam line nozzles, time for removal will increase; and completion of inboard MSIV work is mandatory. This was the case.

ACTIVITY SERVICE PLAN
RF-41

1. Activity Title: Torque Moisture Separator
2. Location: Reactor well.
3. Work Description: Latch moisture separator holddown bolts.
4. Scheduling Information: 4 hours.
   (H) 1-1/2 hours.
   (QC) 1 hour
   (F) 6 hours.
   (BF) 7 hrs. elapsed time. 5 locking devices had to be unstuck with hammer taps, which took an additional 8 hours elapsed time.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 4 mechanics.
      1 supervisor
   d. Recovery: None.
6. Special Equipment/Tools: Four shroud head bolt wrenches.
   (F) Two shroud head bolt wrenches.
   (BF) Four shroud head bolt wrenches. (BF-1 used only 2 wrenches.)
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites: Moisture separator positioned properly.
   (F) Moisture separator positioned properly.
   Cavity decon completed.
9. Procedures: MMI-10.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 60 mrem/hr.
    (H) 30 mrem/hr.
    (QC) 30 mrem/hr.
    (F) 40 mrem/hr.
12. Total MAN-REM: 4 hours x 5 men x 60 mrem/hr. = 1.2 MAN-REM.
13. Personnel Protection: None.
    (F) 1 pair Anti-C and rubber pants.
14. Remarks: Work might be performed more easily from the service platform.
    (H) Work might be performed more easily from the service platform. Done. Maintenance was not familiar procedures. Did not realize that there was a torque valve for these bolts.
    (QC) Work might be performed more easily from the service platform. Done from flange.
    (F) Done from flange.

ACTIVITY SERVICE PLAN
RF-42

1. Activity Title: Install Steam Dryer
2. Location: Reactor well, refueling floor
3. Work Description: Attach strongback; rig, lift, and position in reactor vessel.
   (F) No game
4. Scheduling Information: 2 hours.
   (H) 1 hour.
   (F) 1 hour.
   (BF) 2 hours. 1 hour to put in place, 1 hour to tighten down.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 4 mechanics, 1 rigger, 4 laborers (continuous spray), 1 crane operator, 1 supervisor, 1 HP
   d. Recovery: 1. Decontaminate strongback,
      2. Wash out equipment pool.
      (H) 1. Decontaminate strongback.
      2. Wash out equipment pool.
      To be done later.
6. Special Equipment/Tools: Strongback, 200 ft. rope, air hoses, water hoses.
   (F) Strongback, 100 ft. rope, air hoses, water hoses.
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites: 1. Steam plugs removed.
   2. Separator holddown bolts latched.
   3. Arrangements made to manually spray the dryer during transfer.
9. Procedures: MMI-10.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 100 mrem/hr.
    (F) 60 mrem/hr.
12. Total MAN-REM: 1 hr. x 8 men x 100 mrem/hr. = 0.8 MAN-REM.
13. Personnel Protection: 1 set of Anti-C clothing.
14. Remarks:
    (F) This activity was performed smoothly and in a timely manner.

ACTIVITY SERVICE PLAN
RF-43

1. Activity Title: Install Transfer Slot Studs
2. Location: Refueling floor, reactor well.
3. Work Description: Rig and lift stud storage racks into reactor well, install studs, install remaining protectors.
4. Scheduling Information: 2 hours for four studs. May be performed in parallel with separator latching.
   - (H) 2 hours for four studs. Not done in parallel with separator latching.
   - (QC) 2 hours for 10 studs. (5 slot, 5 that foul head.) May be performed in parallel with separator latching. Done after head on.
   - (F) 3 hours for four studs. May be performed in parallel with separator latching. See remarks.
   - (BF) Actual 2-1/2 hrs.
5. Manpower
   - a. Special Skills: None.
   - b. Prefabrication: Clean and lubricate studs - 2 mechanics (15 minutes/stud).
     - (U) Clean and lubricate studs - Done on critical path 2 mechanics (15 minutes/stud).
   - c. Performance: 1 rigger
     3 mechanics
     1 crane operator
     1 supervisor
     - (H) 3 mechanics
       1 crane operator
     - (F) 2 mechanics
       1 crane operator
       1 supervisor
   - d. Recovery: None
6. Special Equipment/Tools: Stud removal tool, breaker wrench, strap wrench, necessary stud protectors.
   - (H) Stud removal tool, breaker wrench, necessary
   - (QC stud protectors.
   - (QC) Stud removal tool.
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites: 1. Cattle chute removed.
   2. Water level below vessel flange.
   3. Stud and bushing ISI must be complete.
9. Procedures: MMI-1.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 60 mrem/hr.
    - (QC) 30 mrem/hr.
12. Total MAN-REM: 2 hrs. x 4 men x 60 mrem/hr = 0.48 MAN-REM.
13. Personnel Protection: 2 sets of Anti-C clothing.
14. Remarks: It is recommended that a small pump be used to remove standing water in stud holes.
    - (H) Removed water with a measuring cup.
    - (F) This activity was performed in a leisurely manner during a 24-hr period when no other critical path work was planned due to man power shortage (Union clam bake previous day).

ACTIVITY SERVICE PLAN
RF-44

1. Activity Title: Remove Flange Protectors, Clean Flange.
2. Location: Reactor well.
3. Work Description: Remove flange protectors and clean vessel flange.
4. Scheduling Information: 1-1/2 hours.
   (H) 1/2 hour.
   (QC) 2 hours.
   (F) 1 hour.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 1 rigger, 4 mechanics, 1 crane operator — 1 supervisor, 1 HP part time
      (H) 30 mechanics, 1 crane operator — 1 supervisor, 1 HP part time
      (F) 4 mechanics, 1 crane operator — 1 supervisor
   d. Recovery: Disassemble, decontaminate, and store protector - (2 mechanics, 1 supvr, HP part time, - hours).
      (F) None
6. Special Equipment/Tools: None
7. Material (spare parts, special consumables, etc.): Four matched 15 ft chokers.
   (F) 2 matched 15 ft chokers. Removed individual sections.
8. Prerequisites: 1. Dryer installed
   2. Water level below flange
   3. Studs installed.
9. Procedures: MMI-10.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 80 mrem/hr.
    (H) 30 mr/hr.
    (QC) 60 mrem/hr.
    (F) 60 mrem/hr.
    (BF) 110 mrem/hr.
12. Total MAN-REM: 5 men x 1.5 hrs. x 80 mrem/hr. = 0.6 MAN-REM.
13. Personnel Protection: 2 sets of Anti-C clothing.
14. Remarks: This activity should be done just before installing the RPV head.
    (F) This activity should be done just before installing the RPV head. About 8 hrs before RPV head install.

ACTIVITY SERVICE PLAN
RF-45

1. Activity Title: Install Reactor Pressure Vessel Head
2. Location: Reactor well and refueling floor.
3. Work Description: Rig strongback to RPV head, clean flange, install O-rings.
   (F) Rig strongback to RPV head, clean flange, install O-rings, install RPV head, remove and store strongback.
4. Scheduling Information: 2 hours.
   (H) 7-1/2 hours.
   (QC) 3 hours.
   (F) 14 hours.
   (BF) Elapsed time 4-1/2 hours, which included 2-1/2 hours lost time - see remarks below.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: Installation of O-rings (4 mechanics, 1 supervisor, 2 hours).
      (BF) Used 8 men and two supervisors.
   c. Performance: 4 mechanics, 1 rigger, 1 supervisor, 1 HP part time, 1 crane operator
      (H) 4 mechanics, 1 supervisor (rigger), 1 HP part time, 1 crane operator
      (QC) 4 mechanics, 1 rigger, 1 supervisor, 1 HP part time, 1 crane operator, 1 signal man on RF
      (F) 2 mechanics, 1 supervisor, 1 crane operator
   d. Recovery: None.
6. Special Equipment/Tools: Strongback, Guide caps.
7. Material (spare parts, special consumables, etc.): - O-rings.
   (BF) O-rings. O-rings were laid out on floor in path of all traffic where they could be easily damaged.
8. Prerequisites:
   1. Flange cleaned
   2. Studs installed with protectors and guide caps.
   3. All internals installed.
9. Procedures: MMI-10.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 80 mrem/hr.
    (H) 30 mr/hr.
    (QC) 60 mrem/hr.
    (BF) 35 mrem/hr at the top rail of cavity.
12. Total MAN-REM: 5 men x 1.5 hrs. x 80 mrem/hr = 0.6 MAN-REM.
13. Personnel Protection: 2 sets of Anti-C clothing.

14. Remarks: This activity should be done just before installing the RPV Head.

(H) This activity should be done just before installing the RPV Head.
Add prerequisite that vessel should be leveled in 2 planes before attempting to set.
Add prerequisite that vessel flange should be cleaned prior to setting. Can be performed with these mechanics.

(QC) None

(F) None

(BF) This activity should be done just before installing the RPV Head.

(1) Lost time (2 hrs) due to fact that just prior to lowering head on vessel, the head was raised and put back on floor. Instrumentation for water level wasn't functioning properly so they wanted to visually see level because they were in process of changing MSRV.

(2) Lost time (1/2 hr) because setting float switch for leak detection was in critical path.

ACTIVITY SERVICE PLAN
RF-46

1. Activity Title: Remove Stud Protectors and Install Nuts and Washers
2. Location: Reactor well and refueling floor
3. Work Description: Lower nuts and washers into reactor well, remove stud protectors, clean and lubricate studs, install washers, and install nuts.
4. Scheduling Information: 16 hours (can be performed in parallel with RPV heatup).
   - (H) 5 hrs (can be performed in parallel with RPV heatup). 1-1/2 hr to run down nuts.
   - (QC) 10 hours (can be performed in parallel with RPV heatup right.)
   - (F) 12 hours (can be performed in parallel with RPV heatup).
   - (BF) (Acutally more than 24 hours elapsed time.)
5. Manpower
   - a. Special Skills: None.
   - b. Prefabrication: Clean and lubricate nuts - (4 mechanics - 4 hours).
   - c. Performance: 8 mechanics
     1 crane operator
     1 supervisor
     2 riggers (part time)
     - (H) 5 mechanics
       1 crane operator
       1 supervisor
     - (QC) 4 mechanics
       1 crane operator
       1 supervisor
     - (F) 6 mechanics
       1 crane operator
       1 supervisor
   - d. Recovery: None.
6. Special Equipment/Tools: Nut spinners, two air motors, stud protector rack, one set of 4-way slings, air hoses.
   - (H) Nut spinners, one air motor, one set of 4-way slings, air hoses.
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites: 1. Vessel head installed.
9. Procedures: MMI-1.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 50 mr/hr.
    - (H) 30 mr/hr.
    - (QC) 30 mrem/hr.
    - (F) 25 mrem/hr.
12. Total MAN-REM: 9 men x 14 hrs. x 50 mrem/hr = 6.3 MAN-REM
13. Personnel Protection:
14. Remarks:
    - (QC) Half off prior head installed.

ACTIVITY SERVICE PLAN
RF-47

1. Activity Title: Tension Reactor Pressure Vessel Studs
2. Location: Refueling floor and reactor well.
3. Work Description: Measure unloaded studs; tension studs; make final measurements, calculations, and adjustments.
4. Scheduling Information: 28 hours.
   - (H) 27 hours. Started at 8:30
   - (QC) 12 hours. Actual work, start delayed 16 hrs due to out of cal gap and stuck hoist. 50 passes, ∿4/hr.
   - (F) 40 hours.
   - (BF) 28 hours. (Actual 32 hours) but much time spent on initial operations - 90% of operations were completed in the last 17 hours.
5. Manpower
   - a. Special Skills: 20 percent experienced personnel.
   - b. Prefabrication: None.
   - c. Performance: 10 mechanics; 1 supervisor (experienced); 2 machinists part time; 1 engineer; 1 quality control inspector part time
     - (QC) 5 mechanics - two crews of 5 alternating; 1 supervisor (experienced)
     - (F) 4 mechanics; 1 supervisor (experienced); 1 engineer
   - d. Recovery: Remove and store elongation rods and install stud inserts - (4 mechanics - 2 hours).
6. Special Equipment/Tools: Contact pyrometer, depth dial indicators (5), elongation rods.
   - (QC) Depth dial indicators (5), elongation rods.
   - (F) Contact pyrometer, depth dial indicator (5), one elongation rod.
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites:
   1. Calibrate pyrometer.
   2. Flange and head metal temperature above the applicable minimum value.
   3. Establish communications with control room.

   (H)
   1. Calibrate pyrometer contact thermometer.
   2. Flange and head metal temperature above the applicable minimum value.
   3. Establish communications with control room.

   (QC)
   1. 120°F
   2. Flange and head metal temperature above the applicable minimum value.
   3. Establish communications with control room.
9. Procedures: MMI-1.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 50 mrem/hr.
    - (QC) 30 mrem/hr.
    - (F) 25 mrem/hr.
    - (BF) 110 mrem/hr.
12. Total MAN-REM: 24 hrs. x 12 men x 50 mrem/hr. = 14.4 MAN-REM.
13. Personnel Protection: 2 sets of Anti-C clothing
14. Remarks

ACTIVITY SERVICE PLAN
RF-48

1. Activity Title: Install Reactor Pressure Vessel Thermocouples and Insulation
2. Location: Reactor well and refueling floor.
3. Work Description: Install thermocouples, install insulation package, connect thermocouples.
4. Scheduling Information: 2 hours.
   - (H) 1-1/2 hours.
   - (F) 8 hours. (4 hrs unusual delay included) see remarks.
   - (BF) Elapsed time 3 hours.
5. Manpower
   - a. Special Skills: None.
   - b. Prefabrication: None.
   - c. Performance: 1 rigger, 4 mechanics, 2 instrument mechanics, 1 crane operator, 1 supervisor
     - (H) 4 mechanics, 2 inst. mech., 1 crane operator, 1 supervisor
     - (F) 4 mechanics, 2 instrument mechanics part time, 1 crane operator, 1 supervisor
   - d. Recovery: None.
6. Special Equipment/Tools: RPV head strongback.
   - (H) 4 matched chokers.
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites: 1. Studs tensioned and inserts installed.
   2. Carousel removed.
   - (H) 1. Studs tensioned.
     2. Carousel removed.
   - (F) 1. Studs tensioned and inserts installed.
     2. Not used.
9. Procedures: MMI-1.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 50 mr/hr.
    - (H) 30 mr/hr.
    - (QC) 30 mrem/hr.
    - (F) 25 mrem/hr.
12. Total MAN-REM: 1 hr. x 6 men x 50 mrem/hr = 0.3 MAN-REM.
13. Personnel Protection: 2 sets of Anti-C clothing.
    - (H) 1 set of Anti-C clothing.
14. Remarks:
    - (QC) No problems on this job.
    - (F) The insulation lower annular flange was left out inadvertently. The insulation package was again raised clear of the head and the flange installed. The second time the insulation package was lowered, it caught on the outer skirt and had to be worked down carefully a little at a time using pry bars.

ACTIVITY SERVICE PLAN
RF-49

1. Activity Title: Install Head Vent and Spray Piping.
2. Location: Reactor well and top elevation of drywell.
3. Work Description: Rig, lift, and position head spray line; remove blind flanges; connect and bolt five flanges; install pipe restraints and insulation.
4. Scheduling Information: 12 hours.
   (H) 14-1/2 hrs.
   (QC) 13-1/2 hours.
   (F) 14 hours.
   (BF) 24 hours.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 5 mechanics
      1 rigger
      1 crane operator
      1 supervisor
   (H) 5 mechanics
      1 crane operator
      1 supervisor
   (F) 4 mechanics
      0 rigger
      1 crane operator
      1 supervisor
   d. Recovery: None.
6. Special Equipment/Tools: Calibrated torque wrench.
   (F) Calibrated torque wrench. 2 chain falls to jack flanges into alignment for bolting.
7. Material (spare parts, special consumables, etc.): Gaskets.
8. Prerequisites: 1. RPV head insulation installed.
9. Procedures: MMI-1.
10. Periodicity: Once per refueling outage.
11. Estimated work area radiation field: 30 mrem/hr.
    (F) 20 mrem/hr.
12. Total MAN-REM: 30 mrem/hr. x 10 hrs. x 6 men = 1.8 MAN-REM.
13. Personnel Protection: 2 sets of Anti-C clothing.
14. Remarks: Coordinate with operations to begin valve lineup for operational hydro.
    (H) Coordinate with operations to begin valve lineup for operational hydro. Not Done.
       1. 4 hrs lost looking for torque wrenches
       2. 1-1/2 hrs. looking for 2" socket
       3. Did not have proper gaskets
    (QC) Coordinate with operations to begin valve lineup for operational hydro. Not done, valve lineup after maint. done.

ACTIVITY SERVICE PLAN
RF-50

1. Activity Title: Perform Reactor Pressure Vessel Hydro.
2. Location: Reactor well.
   (BF) Reactor well. (Note: 1000 psi at 200°F).
3. Description: Pressurize vessel, inspect for leaks.
   (F) Value lineup. Pressurize vessel, inspect for leaks.
4. Scheduling Information: 15-18 hours.
   (H) 24 hours
   (QC) 4-1/2 hours
   (F) 3 days
   (BF) 20 hours to compile leak must total 24 hrs to stop all leaks.
5. Manpower:
   a. Special Skills: None
   b. Prefabrication: None
      (F) 24 hrs vlv lineups
   c. Performance: 2 quality control inspectors (part time).
      (F) SSS and one or 2 operators
   d. Recovery: Depends on leakage.
      (H) Depends on leakage. One CRD leaking - will scram latch sealed.
6. Special Equipment/Tools: None.
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites: 1. Primary coolant boundary established.
   2. Vessel filled.
   (F) 1. Primary coolant boundary established.
   2. Vessel filled.
   3. Valve lineups.
   4. Radwaste or cond. to receiving water disch.
9. Procedures: GOI-100-7.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 30 mrem/hr.
    (H) None
    (QC) 30 mrem/hr. DW background.
12. Total MAN-REM: 2 men x 2 hrs. x 30 mrem/hr. = 0.12 MAN-REM.
13. Personnel Protection: 2 sets of Anti-C clothing, in reactor well.
14. Remarks:
    (QC) No leakage except O-ring inner - utility routinely accepts this unit II now operating after startup with inner O-ring leak.
    (F) Several interruptions for leaks. 47# H SRV lifted, solenoid lifted. Body to bonnet SD cooling suct and RCIC inside stm supply. Packing inbd MSIV's.
    (BF) Reactor Pressure 1000 (±5) psig). Reactor Temp. 200°F Limit to 50 psi change per min. Used RHR and Main Recirc pump to heat up. Used CRD pump and CU rundown to cond. to maintain pressure.

ACTIVITY SERVICE PLAN
RF-51

1. Activity Title: Open Drywell Vents
2. Location: Reactor well.
3. Work Description: Open drywell vents.
4. Scheduling Information: 30 minutes. Performed in parallel with head spray and vent piping installation and during insulation installation.
   (F) (Not done in parallel)
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 2 mechanics.
      (F) 4 mechanics.
   d. Recovery: None.
6. Special Equipment/Tools: None.
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites: 1. Reactor pressure vessel tensioned.
   (H) 1. Reactor pressure vessel tensioned.
       2. Minor Insulation installed.
9. Procedures: N/A.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 30 mrem/hr.
12. Total MAN-REM: 2 men x 5 hrs. x 30 mrem/hr. = 0.03 MAN-REM.
13. Personnel Protection: 2 sets of Anti-C clothing.
14. Remarks: To protect T.C. leads, open associated vent just after head insulation is installed.
   (H) To protect T.C. leads, open associated vent just after head insulation is installed.
       Overhead crane is restricting factor.

ACTIVITY SERVICE PLAN
RF-52

1. Activity Title: Install Drywell Head.
2. Location: Reactor well and refueling floor.
3. Work Description: Clean flanges, install O-rings, rig and install drywell head.
4. Scheduling Information: 4 hours.
   (H) 2 hours.
   (F) 6 hours.
   (BF) 5 hours.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
      (H) 4 hrs. cleaning cavity → critical path.
   c. Performance: 1 rigger, 4 mechanics, 1 supervisor, 1 HP (part time), 1 crane operator
      (F) 6 mechanics, 1 supervisor, 1 HP (part time), 1 crane operator
   d. Recovery: None.
6. Special Equipment/Tools: Strongback, basket wrenches.
   (F) Strongback.
7. Material (spare parts, special consumables, etc.): O-rings.
8. Prerequisites: Vessel hydro performed.
   (H) Vessel hydro not done.
   Cavity grating area and mirror insulation must be cleared of all equipment and tools.
   (QC) Vessel hydro performed.
   4 mech. tapping out nuts to remove rust, etc.
   (F) Vessel hydro performed.
   Clean metal seating surfaces, check gasket. Remove flange protector.
9. Procedures: MMI-2.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 30 mrem/hr.
12. Total MAN-REM: 2 hrs. x 5 men x 30 mrem/hr = 0.3 MAN-REM.
13. Personnel Protection: 2 sets of Anti-C clothing
14. Remarks
   (H) Lifted thread protection six at a time. Need a better way.
   (F) No problems with this job.

ACTIVITY SERVICE PLAN
RF-53

1. Activity Title: Bolt and Leak-Rate Test Drywell Head
2. Location: Inside reactor well.
3. Work Description: Torque drywell head bolts, leak-check.
4. Scheduling Information: 8 hours
   (H) 6 hours, parallel with E/P blocks
   (F) 14 hours.
   (BF) 8 hours. Leak Test 1 hr.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 1 rigger, 1 supervisor, 1 test engineer part time, 5 mechanics, 1 quality control inspector
   d. Recovery: None.
6. Special Equipment/Tools: Two impact wrenches with sockets and air hoses, pressure test rig, basket wrenches.
   (F) 12 impact wrenches, 2 electric drives with sockets and air hoses, pressure test rig, basket wrenches.
   4 hydraulic jacks, 50-ton ea, head is 3/8" out of round.
   Feeler gages to ensure even all around.
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites: 1. Drywell head installed.
9. Procedures: MMI-2.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 30 mrem/hr.
12. Total MAN-REM: 7 hrs. x 7 men x 30 mrem/hr. = 1.47 MAN-REM.
13. Personnel Protection: 2 sets of Anti-C clothing and possibly full face masks.
14. Remarks:
   (F) The head is pulled down with the bolts going around unit impacts while holding in shape with jacks.

B-86

ACTIVITY SERVICE PLAN
RF-54

1. Activity Title: Integrated Leak Rate Test (Drywell)
   (H) Not Done.
   (QC) Not Done
   (F) Not Done
   (BF) Not Done
2. Location: Reactor well and refueling floor.
3. Work Description: Pressurize primary containment, monitor for leakage.
4. Scheduling Information: 96 hours.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: Install drywell head, torque head bolts, and perform LLRT, (1 rigger, 5 mechanics, 1 quality control inspector, 1 supervisor, 1 test engineer - 12 hours).
   c. Performance: 1 test engineer.
   d. Recovery: Remove drywell head (1 rigger, 5 mechanics, 1 supervisor - 9 hours).
6. Special Equipment/Tools: Test rig
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites:
   1. Vessel head removed or preferably vessel vented to drywell with vessel head installed.
   2. Normal operational water level established and proper valve lineup.
   3. Test equipment must be installed in the drywell.
   4. Required LLRT's performed.
   5. Hatches between drywell and reactor cavity must be opened.
9. Procedures: SI 4.7.A.2
10. Periodicity: Once every 40 months.
11. Estimated work area radiation field: 50 mrem/hr.
12. Total MAN-REM: 2 men x 2 hrs. x 50 mrem/hr = 0.2 MAN-REM.
13. Personnel Protection: Refueling floor must be evacuated during pressurization.
14. Remarks: Note that this activity requires that the drywell head be installed and removed out of the normal sequences of refueling floor activities.

ACTIVITY SERVICE PLAN
RF-55

1. Activity Title: Install Reactor Well Shield Blocks
2. Location: Refueling floor.
3. Work Description: Rig, lift, and install two layers of reactor well shield blocks.
4. Scheduling Information: 8 hours.
   (H) 10 hours estimated.
   (BF) 4 hours.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 1 rigger
      4 mechanics
      1 supervisor
      1 crane operator
   d. Recovery: Remove cribbing - (4 mechanics - 4 hours),
6. Special Equipment/Tools: Matched pair of slings.
7. Material (spare parts, special consumables, etc.): Matched pair of slings.
8. Prerequisites: 1. Equipment and fuel pool gate plugs installed.
   2. Drywell head installed.
9. Procedures: MMI-24.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: Less than 5 mrem/hr.
12. Total MAN-REM: Insignificant.
13. Personnel Protection: 1 set Anti-C clothing.
14. Remarks:

ACTIVITY SERVICE PLAN
RF-57

1. Activity Title: Preoperational Test and Inspection of Tools and Equipment
2. Location: General.
3. Work Description: Assemble (if necessary), preoperational test those tools listed in "Remarks".
4. Scheduling Information: Should be accomplished before reactor shutdown. Some work can be paralleled with refueling floor activities.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: Plant machinists and electricians.
   d. Recovery: None.
6. Special Equipment/Tools: None.
   (F) Rigging OK.
7. Material (spare parts, special consumables, etc.): Spare parts as required.
8. Prerequisites: None.
   (F) None. Laydown areas not established. HP not prepared. Tools not on floor.
9. Procedures: As listed on appropriate activity service plan.
10. Periodicity: Before each refueling outage.
11. Estimated work area radiation field: None.
12. Total MAN-REM: None.
13. Personnel Protection: None.
14. Remarks: Tools and equipment to be preoperationally tested:
    1. Impact wrenches
    2. Stud tensioners.
    3. Air motors for heat nut spinners
    4. Dryer-separator strongback (test underwater)
    5. Main steam line plugs (especially rubber parts and fittings)
    6. Fuel grapple.
    7. Instrument grapple.
    8. Sipping equipment (if sipping is scheduled)
    9. Stud removal tool.
    10. Service platform.
    11. Jib crane
    12. Underwater TV camera and lights
    13. Videotape machine
    14. Refueling bridge (including hoists)
    15. LLRT test equipment
    16. Blade guides
    17. Dunking Chamber
    18. Overhead crane
    19. Slings and chokers
    20. LPRM Strongback
    21. Check spare parts for underwater lights, cameras, etc.
    22. Check spare parts for drywell head, reactor head, head piping, etc.
    23. Check availability of consumables such as plastic bags, Acetone, Never-Seize, clothes, castor oil, etc.

ACTIVITY SERVICE PLAN
RF-56

1. Activity Title: Channel Inspection
2. Location: Refueling Floor Fuel Storage Pool Curb
3. Work Description: Visual inspection of wear marks for comparison against a calibrated standard.
4. Scheduling Information: 4 channels/hours. May be performed in conjunction with fuel sipping, fuel inspection, and rechanneling.
   (H) 6-1/2 channels/hr. Not done in conjunction with fuel sipping, fuel inspection, and rechanneling.
   (BF) 4 channels/hours. May be performed in conjunction with fuel sipping, fuel inspection, and rechanneling. 38 channels were inspected. Started 10/3/77, completed 10/5/77, elapse time = 24 hours.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 1 refueling bridge operator
      1 evaluation engineer
      2 inspectors.
   d. Recovery: None.
6. Special Equipment/Tools: Full prep machine with upper and lower scope, boroscope, underwater lights, actuator poles, calibration standards.
   (BF) Full prep machine with upper and lower scope, boroscope, underwater lights, actuator poles, calibrated standards. Used metal measuring tape hooked over top of fuel element.
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites: Fuel Bundle unloaded.
9. Procedures: None.
10. Periodicity: At station's request.
11. Estimated work area radiation field: 5 mrem/hr. at fuel pool curb.
12. Total MAN-REM: 4 hrs x 3 men x 5 mrem/hr. = 0.06/4 channels.
13. Personnel Protection: None.
14. Remarks:

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ACTIVITY SERVICE PLAN
RF-58

1. Activity Title: Feedwater Sparger Inspection
2. Location: Refueling floor, inside reactor well and vessel.
3. Work Description: Install platform and shielding, inspect feedwaters, remove one feedwater sparger, clean and penetrant inspect nozzle bore, install one feedwater sparger, remove platform and shielding.

   (H) Install platform and shielding, inspect feedwaters, take cold spring measurements and as results, remove one feedwater sparger, clean and penetrant inspect nozzle bore, install one feedwater sparger, remove platform and shielding.
4. Controlling Path Schedule: 54 hours.

   (H) 24 hrs - Visual insp, (no pt) take cold spring measurements, vessel contour and dial-a-bore and remove spargers.
5. Required Resources: None.
   a. Manpower
      1. Special Skills:
      2. Prefabrication:
      3. Performance: 2 machinists; 4 mechanics; 4 penetrant Level I inspectors; 2 penetrant Level II inspectors; 1 crane operator; 1 quality control inspector (part time)
      4. Recovery: None.
   b. Equipment/Tools: Inspection platform, lead shielding, extension ladder, two 10-ton jacks, sparger removal tools, jacking brace, dynamometer, dial indicators.

      (H) Inspection platform, lead shielding, extension ladder, four 10-ton jacks, 2 - 4' crow bars, jacking brace, dynamometer, dial indicators. As built (special) tools.
   c. Material: None.

      (H) Acetone, C, OH,
6. Prerequisites:
   1. Water to be lowered to proper level.
   2. Vessel isolated.
   3. Core sprayline flushed.
   4. Vessel De-conned
   5. Sparger tools checkout.
7. Procedures: As required.

   (H) As supplied by G.E.
8. Periodicity: As required.
9. REM Information
   a. Estimated 500 mr/hr
   b.
   c. Personnel protection: supplied air, lead shields.
10. Remarks:

ACTIVITY SERVICE PLAN
DW-1

1. Activity Title: Drywell Entry
   (H) Drywell Entry (no GAME)
2. Location: Drywell
3. Work Description: De-inert drywell, cool down, take radiation surveys, make oxygen analysis.
   (QC) De-inert drywell, cool down, take radiation surveys, make oxygen analysis. Inspect for leaks.

   (F) De-inert drywell, cool down, take radiation surveys, make oxygen analysis. Inspect for loose pipes gratings, etc.
4. Scheduling Information: 8-10 hours from reactor scram to drywell entry. De-inerting may begin 24 hours prior to reactor scram.
   (H) 10 hours from reactor scram to drywell entry. De-inerting may begin 24 hours prior to reactor scram. 4 additional hours for D.W. temperature to cool to ambient.
   (QC) 0 hours from reactor scram to drywell entry. De-inerting began 4 hours prior to reactor scram.
   (F) 6 hours from reactor scram to drywell entry. De-inerting may begin 24 hours prior to reactor scram.
   (BF) 24 hours from reactor scram to drywell entry. De-inerting may begin 24 hours prior to reactor scram. 24 hrs. because of delay in entering due to high temperature. Delay in ventilating.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: Operations personnel.
      (H) Operations personnel. Mechanics (4) to open Equip. Hatches both hatches opened immediately.
   d. Recovery: None.
6. Special Equipment/Tools: None.
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites: Reactor shutdown.
   (F) Reactor shutdown. D/W purged of nitrogen.
9. Procedures:
10. Periodicity: Once each outage.
11. Estimated work area radiation field: 30 mrem/hr general area inside Drywell.
12. Total MAN-REM: N/A
13. Personnel Protection: 1 set of Anti-C clothing, face masks.
14. Remarks:
    (H) Scaffolding and walk way installation began promptly as well lamping.
    (QC) Entry made as soon as D/W de-inerted. Rx at full pressure. Have made entry at low power level. Key in when generator comes off-entry in mode.
    (BF) 12-hour delay because of air borne contamination (before containment could be broken)

ACTIVITY SERVICE PLAN
DW-2

1. Activity Title: Leak Rate Test for Drywell to Torus Vacuum Breakers
    (F) Leak Rate Test for Drywell to Torus Vacuum Breakers (not done)
2. Location: 1st floor, reactor building.
    (BF) 1st floor, reactor building, tested 1st valve in the torus
3. Work Description: Establish and maintain 1 psid between drywell and torus, record rate of pressure increase on torus to determine the leakage rate.
4. Scheduling Information: 10 hours. May be done in parallel with reactor cooldown.
    (BF) 12 hours. May be done in parallel with reactor cooldown. This is for test only, it is necessary to remove arm and position switch prior to this.
5. Manpower
    a. Special Skills: None.
    b. Prefabrication: None.
    c. Performance: Operations personnel, 2 test engineers.
    d. Recovery: None.
6. Special Equipment/Tools: Test rig.
    (BF) Test rig. Vacuum pump, hoses, gauges, plastic cover.
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites: 1. Reactor in shutdown mode.
    2. All suction and discharge valves adjacent to the torus should be tagged out.
    3. Drywell is closed and evacuated.
9. Procedures: SI 4.7.A.4
10. Periodicity: Once each refueling cycle and after vacuum breaker repair.
11. Estimated work area radiation field: Less than 5 mrem/hr.
12. Total Man-Rem: Insignificant.
13. Personnel Protection: N/A.
14. Remarks: None.
    (BF) Tested at 36" Hg decrease allowable = 10" Hg in one minute. Witnessed local leak rate testing only (individual valve).

ACTIVITY SERVICE PLAN
DW-3

1. Activity Title: Torus Vacuum Breaker Inspection and Repair
   (H) Torus Vaccum Breaker Inspection and Repair. Not done
   (QC) Torus Vacuum Breaker Inspection and Repair. MMI-48
2. Location: Torus, 1st floor reactor building, and drywell.
3. Work Description: Check operability, leak test, repair limit switches and seals as necessary.
   (F) Clean seats, reassemble.
4. Scheduling Information: 10 hours/vacuum breaker
   (F) 5 hours/vacuum breaker
   (BF) Variable
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 6 fitters
      2 test engineers
      1 HP part time
      1 supervisor
   (F) 2 fitters, 1 HP part time, 1 supervisor } per valve
   d. Recovery: Perform total leak rate test for torus/drywell vacuum breakers per SI-4.7.A.4
6. Special Equipment/Tools: Test rig and special vacuum breaker fixture.
7. Material (spare parts, special consumables, etc.): Vacuum breaker spare parts.
8. Prerequisites: 1. Total leak rate test performed on drywell/suppression chamber vacuum breakers indicates excessive leakage.
   2. Reactor in cold shutdown with the shutdown cooling system operable per Tech Specs.
9. Procedures: MMI-48, SI 4.7.A.4
10. Periodicity: As required per testing
11. Estimated work area radiation field: 20 mrem/hr.
12. Total MAN-REM: 0.3 MAN-REM
13. Personnel Protection: 1 set Anti-C clothing
14. Remarks: None.
   (BF) Temperature and humidity quite high in torus, this tends to extend work time due to frequent breaks.

ACTIVITY SERVICE PLAN
DW-4

1. Activity Title: Torus ISI
2. Location: Outside the torus
3. Work Description: UT torus shell and seismic anchor bolts
   (F) UT torus shell and seismic anchor bolts (not done)
   (BF) UT torus shell and seismic anchor bolts (not done)
4. Scheduling Information: 4 hours.
5. Manpower
   a. Special Skills: Level II UT.
   b. Prefabrication: None.
   c. Performance: 2 NDT personnel.
   d. Recovery: None.
6. Special Equipment/Tools: UT equipment.
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites: None.
9. Procedures: None.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field:
12. Total MAN-REM:
13. Personnel Protection:
14. Remarks:

ACTIVITY SERVICE PLAN
DW-5

1. Activity Title: Torus Inspection
2. Location: Inside the Torus.
3. Work Description: Inspect visible piping supports, ring girder, catwalk, penetrations (both internal and external), and paint.
   (F) Inspect visible piping supports, ring girder, catwalk, penetrations (both internal and external), and paint. Inspect selected areas for the oxide build-up.
4. Scheduling Information: 10 hours.
   (QC) 5 hours for vent above water - additional work required below water - 7 shifts with diver - division then unable to paint about 200 ft^2 of surface. 1 shift for visual inspection.
   (F) 10 hours. 2 weeks - cleanup (deslugging and hydrolasing)
   (BF) 2 hours. Second Inspection 1 hour. Daily inspection duration of 1 hr. are being conducted because of paint problem.
5. Manpower
   a. Special Skills: None.
      (F) Know how to use tools to measure corrosion pitting size and paint thickness.
   b. Prefabrication: 2 mechanics (to open hatch) - 2 hours.
      (F) 20 mechanics (to open hatch) clean torus for inspection.
   c. Performance: 2 engineers
      4 carpenters
      (QC) many engineers
      1 diver, 1 helper
      (F) 2 engineers
      20 craftsmen
      (BF) 2 engineers
   d. Recovery: None.
6. Special Equipment/Tools: 2 man inflatable raft.
   (QC)
   (F) Film gages
   magnifying glass
   UT thickness gage
   Hydrolaser
   Deslugging pumps
   (BF) OK
7. Material (spare parts, special consumables, etc.): O-ring for hatch.
   (QC) O-ring for hatch. Paint.
   (F) O-ring for hatch. Paint for recoating if necessary.
8. Prerequisites: 1. Reactor shutdown
   2. Drywell entry established
   3. Drywell manhole cover open.
   (QC) 4. Water cleaned
   5. Water drained from torus for below water level inspection and painting.
9. Procedures: MMI-44.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 20 mrem/hr.
    (QC) 10 mrem/hr
    (BF) 20 mrem/hr. HP survey indicated 300 D/M. No dress out.

12. Total MAN-REM: 0.25 MAN-REM
(F)

13. Personnel Protection: 1 set Anti-C clothing.
(F) 1 set Anti-C clothing, air supplied mask, plastics.

14. Remarks: Possibility of torus draining if repairs/painting is required.
(QC) Possibility of torus draining if repairs/painting is required. xxxxxxxxxxx only. Use a zinc paint - cures in one day.
(F) Possibility of torus draining if repairs/painting is required. Torus was drained.
(BF) Possibility of torus draining if repairs/painting is required. Initial inspection of torus (after water was removed) indicated only minor maintenance on catwalk grating* and instrumentation** necessary. On inspection five days later small (1/4" diameter) blisters were observed on torus floor. All bays were affected. No definite explanation has been given for cause of blisters. Coating of entire torus has been completed.

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*Small welding

**Air cylinders and associated solenoid valves were rusting extensively thermocouple wire out of unistrut in places

ACTIVITY SERVICE PLAN
DW-6

1. Activity Title: Containment Valve Testing
2. Location: Inside the Drywell and the Reactor Building
3. Work Description: Leak rate and functional test per technical specifications.
4. Scheduling Information: 1 valve - 2 hours (178 valves total).
   (QC) 1 valve - 2 hours (138 valves total).
   (F) 200 total tests performed, 101 test locations, 61 pipe penetrations, 143 valves; 14 hatches; 26 electrical penetrations; 1 test - 4 hours (assumes valves lined up, system drained).
   (BF) Penetration summary

No. of items	Type	No. of Tests
34	bellows	34
33	electrical	33
23	resilient seals	23
127	valves	81
1	airlock	2

5. Manpower
   a. Special Skills: None.
      (QC) (Experienced test engineer)
   b. Prefabrication: None.
   c. Performance: 2 mechanics
      1 test engineer
      (F) 2 instrument technicians per shift.
      days: 1 test engineer
      2 pipefitters
      night: 1 pipefitter
      1 inst tech
      1 engr
      (BF) 2 mechanics
      1 test engineer
      2 shifts 12 and 12
      6 and 4 people
      1 engr each shift
   d. Recovery: None.
6. Special Equipment/Tools: One test rig with fixtures.
   (F) Three test rigs with fixtures.
   Separate rotometer and bubbler
   (BF) One test rig with fixtures. Pressurized water reservoir w/ gage glass. Leise gage panels (3) for pressure drop testing.
7. Material (spare parts, special consumables, etc.): None.
   (F) Glass tubes for rotometers, 15 extra valves for test panels (they're all the same), each panel has about 15 valves.
8. Prerequisites: 1. Appropriate valves tagged out.
   2. System drained, if applicable.
   (QC) 2. System drained, if applicable. They drain all systems tested and air test all.
   3. Drywell opened for access.

9. Procedures: SI 4.7.A.2G-3
   (BF) Procedure calls for pressurized water reservoir with level gauge to determine leak rate - in all cases a rotometer could be used - more compact, does not have to be recharged.
10. Periodicity: Each valve tested each refueling outage and after valve repair.
11. Estimated work area radiation field: Case basis.
12. Total MAN-REM: N/A
13. Personnel Protection:
14. Remarks: This is type C testing worked in parallel with type 1 (air lock) and type B (penetration and seals).
   (H) This is type C testing worked in parallel with type 1 (air lock) and type B (penetration and seals).
   ("B" loop RHR not available until last days of its outage.
   Angle valve and 3 others failed - repairs holding up startup.
   Apparently might help to schedule individual systems formally)
   (QC) This is type C testing worked in parallel with type 1 (air lock) and type B (penetration and seals). Info. feedback to planner.
   Feedwater check valves failed at O-ring seal on internals.
   (F) This is type C testing worked in parallel with type 1 (air lock) and type B (penetration and seals).
   All electrical penetrations passed 1st time.

ACTIVITY SERVICE PLAN
DW-7

1. Activity Title: Repair of Containment Gate, Globe or Check Valves
2. Location: General (inside drywell or first valve outside drywell).
3. Work Description: Disconnect operator, remove operator, disassemble, repair, reassemble; perform post-maintenance.
4. Scheduling Information: Testing work in parallel with other work and testing.
   (F) Testing work in parallel with other work and testing.
   big valves 18, 20 24" ∿800 man hours
   small 4, 16 100
5. Manpower
   a. Special Skills: 1 man experienced with lapping machine.
   b. Prefabrication: None.
   c. Performance: 1 rigger
      2 mechanics
      1 HP part time
      1 supervisor
      1 engineer part time
   d. Recovery: None.
   (F) a. Special Skills: 1 man experienced with lapping machine.
      b. Prefabrication: None.
      c. Performance: 1 rigger
         2 mechanics
         1 HP part time
         1 supervisor
         1 engineer part time
      d. Recovery: None.
      per valve per test
6. Special Equipment/Tools: As required by vendors manual; lapping machine, lapping block.
   (F) As required by vendors manual; lapping machine, lapping block. Must assume all ∿220 containment valves, assume all will fail and get tooling; parts for repair.
7. Material (spare parts, special consumables, etc.): Vendor-recommended spare parts on site (packing, bonnet gaskets, etc.)
   (F) Vendor-recommended spare parts on site (packing, bonnet gaskets, etc.). Discs and seat rings, stems, yoke bushings, limitorque part, - torque subs, limit subs, gearing
   (BF) Vendor-recommended spare parts on site (packing, bonnet gaskets, etc.). Spare problems were encountered only with Walworth Valves.
8. Prerequisites: 1. Hold order issued for appropriate valves.
   2. Initial testing complete.
   3. System drained.
   (BF) Varies for each system
9. Procedures: MMI-51.

10. Periodicity: As required per testing and inspection.
11. Estimated work area radiation field: Varies (case basis).
12. Total MAN-REM:
13. Personnel Protection:
    (BF) Anti-C's and masks required when opening a valve or grinding a seat.
14. Remarks: Some valves, such as the recirculation suction, discharge, bypass, etc., and some RHR valves, require special plant conditions.
    (QC) Some valves, such as the recirculation suction, discharge, bypass, etc., and some RHR valves, require special plant conditions.
    Note: Feedwater check valves (cone) one did not pass test after repair. It's reported that the "O" Rings do not hold up under the operating condition. One has been repaired twice for leaking seal ring - still leaking.
    (BF) Some valves, such as the hot containment valves and some RHR valves, require special plant conditions. Full face masks required for re-packing Recirc. Gate valves.

ACTIVITY SERVICE PLAN
DW-8

1. Activity Title: MSIV Leak Rate Test
2. Location: Ground level drywell and steam tunnel.
3. Work Description: Make test connections and perform rate test.
4. Scheduling Information: 3 hours/steam line - total 40 hours.
   - (H) 10 hours/steam line - total 40 hours.
   - (QC) 2 hours/steam line - total 12 hours.
   - (F) 4 hours/steam line no water leg combine, and dry - total 12 hours
     12 hours - including water leg
   - (BF) 4 hours/steam line - total 16 hours.
5. Manpower
   a. Special Skills: None.
      - (H) Lead engineer should be familiar with and experienced in MSIV testing.
   b. Prefabrication: None.
   c. Performance: 1 test engineer
      2 mechanics
      1 HP part time
      - (H) 1 test engineer
        3 mechanics
   d. Recovery: None.
6. Special Equipment/Tools: Test rig, air hoses.
7. Material (spare parts, special consumables, etc.):
   - (F) • Spare valves
     • They cannibalize other equipment } Test Equipment
8. Prerequisites: 1. Reactor pressure at atmospheric and plant conditions established per test procedures.
   - (F) 1. Reactor pressure at atmospheric and plant conditions established per test procedures.
     This area needs work - since the leak test operation prevented a vacuum from being drawn on the head during the head disassembly phase.
9. Procedures: SI 4.7.A.2.G-3.
10. Periodicity: Once per refueling outage and after valve repair.
11. Estimated work area radiation field: 5 mrem/hr.
12. Total MAN-REM: 0.1 MAN-REM
13. Personnel Protection: 1 set Anti-C clothing.
14. Remarks:
    - (QC) Done as soon as Rx at 0 pressure.
    - (BF) Pulled vacuum on all 4 lines through MSIV's before testing. Operation told to close MSIV's and pull vacuum through drain lines.

ACTIVITY SERVICE PLAN
DW-9

1. Activity Title: MSIV Repair
2. Location: Ground level drywell and steam tunnel.
3. Work Description: Disassemble, lap valve seat and pilot seat, machine poppet seat, reassemble, repair operators as required.
   (F) Disassemble, lap valve seat and machine pilot seat, machine poppet seat, reassemble.
4. Scheduling Information: 60 hours each valve. Performance of parallel activities on different MSIV's is possible, limited by manpower and resources.
   (H) 36 hours each valve. Performance of parallel activities on different MSIV's is possible, limited by manpower and resources.
   (F) 4 days/valve. 2 days disa, clean, reassembly. Performance of parallel activities on different MSIV's is possible, limited by manpower and resources.
   (BF) (1st 2 valves 108 hours) (2nd 2 valves 192 hours). Performance of parallel activities on different MSIV's is possible, limited by manpower and resources.
5. Manpower
   a. Special Skills: 1 mechanic experienced in lapping tool, 1 experienced engineer
      (H) 1 mechanic experienced in lapping tool, 1 inexperienced engineer
   b. Prefabrication: 6 hours to install rigging and remove insulation and instrumentation (4 insulators, 2 mechanics, 2 riggers, 2 instrument technicians, 4 electricians).
      (H) 16 hours to install rigging and remove insulation and instrumentation (4 insulators, 2 mechanics, 2 instrument technicians, 4 electricians).
   c. Performance:
      4 mechanics
      2 machinists
      1 supervisor
      1 HP part time
      1 engineer
      2 riggers.
      (H) 4 mechanics
      1 machinist
      1 supervisor
      1 HP part time
      0 engineer
      2 riggers
      (F) 4 mechanics
      1 supervisor
      1 HP part time
      1 engineer
      2 riggers
      (BF) 6 mechanics
      2 machinists
      1 supervisor
      1 HP part time
      1 engineer
      2 riggers.

5. Manpower (Continued)
   d. Recovery: Leak test the valve (1 test engineer, 2 mechanics) 3 hours.
6. Special Equipment/Tools: Functionally test the valve - SI 4.7.D.B2. Lathe for machining 26" poppet (lathe will become contaminated), torque wrenches, chain falls, slings, guide studs, poppet valve lifting tool, protective covers for seating surfaces, guide cradle, storage containers, lapping tools, impact wrenches, torque multipliers.
   (F) Functionally test the valve - SI 4.7.D.B2.
   Lathe for machining 26" poppet (lathe will become contaminated), torque wrenches, chain falls, slings, guide studs, eye bolts, protective covers for seating surfaces, guide cradle, storage containers, lapping tools, impact wrenches, torque multipliers.
7. Material (spare parts, special consumables, etc.): Wooden blocks, grip paper, contact glue, gaskets, packing, operator seals and O-rings, bonnet studs, and nuts.
   (F) Wooden blocks, grip paper, contact glue, gaskets, packing, operator seals and O-rings, bonnet studs, and nuts. 4 sets of internals lock pins (for main disc to piston and pilot disc to stem) weld wire and weld procedure to lock weld pins.
8. Prerequisites: 1. Steam lines drained
   2. LLRT indicates excessive leakage.
   3. Equipment hatch must be open for inboard valve repair.
9. Procedures: MMI-17.
10. Periodicity: As required per LLRT's (and at some plants a minimum of one valve each refueling outage).
11. Estimated work area radiation field: 15 mrem/hr.
12. Total MAN-REM: 2.0 MAN-REM.
13. Personnel Protection: 1 set Anti-C clothing.
14. Remarks: If more than one outboard valve is to be repaired, time may be saved by removing outer steam tunnel blow-out panels and block wall.
   (F) N/A no suck panel.
   15 disassemblies/reassemblies performed this outage. Crew became very proficient.

ACTIVITY SERVICE PLAN
DW-10

1. Activity Title: Pipe and Equipment Hanger Inspection and Repair
2. Location: Inside Drywell all levels.
3. Work Description: Inspect and repair pipe and equipment hangers.
4. Scheduling Information: 48 hours - worked in parallel with other drywell activities.
5. Manpower
   a. Special Skills: None.
      (F) 1 engineer for inspection.
   b. Prefabrication: None.
   c. Performance: Inspection - Repair as required
      2 mechanics
      1 supervisor (part time)
   d. Recovery: None.
6. Special Equipment/Tools:
7. Material (spare parts, special consumables, etc.): Spare parts.
   (F) Spare parts. Isometrics of lines.
8. Prerequisites: 1. Drywell entry established.
9. Procedures: N/A.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field: 30 mrem/hr.
    (F) 30 mrem/hr. Average 50-120 mrem/hr above 270
12. Total MAN-REM: less than 0.8 MAN-REM.
13. Personnel Protection: 1 set Anti-C clothing.
14. Remarks:

ACTIVITY SERVICE PLAN
DW-11

1. Activity Title: Inservice Inspection
   (H) Inservice Inspection not observed
   (BF) Inservice Inspection (no GAME)
2. Location: Inside drywell, all levels.
3. Work Description: Remove insulation, build scaffolding, clean required areas, calibrate equipment, UT inspect, clean up areas inspected, replace insulation, remove scaffolding.
4. Scheduling Information: 160 hours. Can be worked in parallel with all work except fuel movement (see "Remarks").
   (QC) 120 hours. (80 hr of UT work). Can be worked in parallel with all work except fuel movement (see "Remarks").
   (F) 450 hours. Can be worked in parallel with all work except fuel movement (see "Remarks").
5. Manpower
   a. Special Skills: 6 UT inspectors (with at least 2 level II included)
      Level III UT inspector part time
      (QC) 10 UT inspectors (with at least 2 level II included)
      Level III UT inspector part time
      (F) 11 UT inspectors (with at least 2 level II included)
   b. Prefabrication: None.
   c. Performance: 6 insulators
      2 supervisors (part time)
      4 carpenters
      (F) 6 insulators
      2 supervisors (part time)
   d. Recovery: Clean up - 4 laborers
6. Special Equipment/Tools: UT equipment with calibration blocks and recorders.
   (F) UT equipment with calibration blocks and recorders. MC
7. Material (spare parts, special consumables, etc.): None.
   (F) None. MC
8. Prerequisites: Drywell entry established.
9. Procedures: SI 4.6.G, DPM BF76E1.
10. Periodicity: Once each refueling outage (see Remark 2).
11. Estimated work area radiation field: Varies.
12. Total MAN-REM:
13. Personnel Protection:
14. Remarks: 1. At many plants, it is required to exclude all personnel from the drywell during all fuel movement.
   2. Plant Technical Specifications specifies percent of total welds to be inspected every 40 months.
   3. Welding may cause electrical interference with UT equipment.
   (QC) 1. At many plants, it is required to exclude all personnel from the drywell only above 2nd level or certain levels during all fuel movement.
   2. Plant Technical Specifications specifies percent of total welds to be inspected every 40 months.
   3. Welding may cause electrical interference with UT equipment. Upper levels done before fuel movement begins. First 5 days spent on special inspections of FW, CRD, C.S., Recirc nozzles and pipe.

14. Remarks: (Continued)

(F) 1. Personnel access not permitted above 2nd level. Only above 2nd Level.
2. Plant Technical Specifications specifies percent of total welds to be inspected every 40 months.
3. Welding may cause electrical interference with UT equipment.
Crouse removed insul GE ISI

(BF) 1. At many plants, it is required to exclude all personnel from the drywell druing all fuel movement.
2. Plant Technical Specifications specifies percent of total welds to be inspected every 40 months.
3. Welding may cause electrical interference with UT equipment.
Core Spray line UT 16 hours.
Work Scope: 1AW 1970 Code must update Nov 78 to new code.
Objective 1/3 of 10 up progr plus all austenitic SS welds (Recirc bypass, core spray lines, CRD return) and everything w/o previous base lines (vessel welds, recirc longitudinals.

ACTIVITY SERVICE PLAN
DW-12

1. Activity Title: Inspect and Repair Snubbers
2. Location: Throughout Drywell.
3. Work Description: Visually inspect all snubbers, remove and test 10 snubbers, rebuild and retest as necessary.
4. Scheduling Information: 16 hours to inspect, 6 hours to remove, 8 hours to test, 4 hours to replace. Rebuild 2 snubbers/shift. Performed in parallel with other drywell activities.
   - (H) 16 hours to inspect, 6 hours to remove, 8 hours to test, 4 hours to replace. Rebuild 4 snubbers/shift. Performed in parallel with other drywell activities.
   - (QC) 16 hours to inspect, 6 hours to remove, 8 hours to test, 4 hours to replace. Rebuild 2 snubbers/shift. Performed in parallel with other drywell activities. Test 2 every 4 hours.
   - (F) 16 hours to inspect, 30 hours to remove, 1 hr/snubber rebuild and test, 30 hours to replace. Rebuild 8 snubbers/shift. Performed in parallel with other drywell activities.
   - (BF) 32 hours to inspect, 6 hours to remove, 8 hours to test, 4 hours to replace. Rebuild 2 snubbers/shift. Performed in parallel with other drywell activities. (150 snubbers at Browns Ferry)
5. Manpower
   a. Special Skills: None.
      (BF) Hydraulic Experience
   b. Prefabrication: None.
   c. Performance: 1 engineer
      4 machinists
      Manpower adjusted as necessary per testing results.
      (QC) 1 supervisor
      2 machinists
      Manpower adjusted as necessary per testing results.
      (F) 1 engineer
      5 machinists to remove and replace
      4 machinists to test and rebuild
      Manpower adjusted as necessary per testing.
      (BF) 1 engineer
      10 Steam Filters
      Manpower adjusted as necessary per testing results.
   d. Recovery: None.
6. Special Equipment/Tools: Shock arrestor test rig.
   (QC) Shock arrestor test rig. Air-operated cylinder on a frame.
7. Material (spare parts, special consumables, etc.): Vendor-recommended spare parts on site and readily available.
   (H) Vendor-recommended spare parts on site and readily available. HNP did not have enough spare parts on hand.
8. Prerequisites: Drywell entry established.
9. Procedures: MMI-36, -45, -59, -59B.

10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field.
    (F) 10-40 mr/hr in DW - test area - 0
12. Total MAN-REM:
13. Personnel Protection:
14. Remarks: For each snubber and subsequent snubber found inoperable, 10 additional snubbers must be tested until no more failures are found, or until all snubbers have been tested. For this reason, beginning this task early may be advisable.
    (H) For each snubber and subsequent snubber found inoperable, 10 additional snubbers must be tested until no more failures are found, or until all snubbers have been tested. For this reason, beginning this task early may be advisable. Forced to remove all snubbers because of failure rate.
    (QC) For each snubber and subsequent snubber found inoperable, 5 additional snubbers must be tested until no more failures are found, or until all snubbers have been tested. For this reason, beginning this task early may be advisable. Began on 17th day of the outage. Do not test any quantative variables. This work let slide because of manpower shortage.
    (F) For each snubber and subsequent snubber found inoperable, 10 additional snubbers must be tested until no more failures are found, or until all snubbers have been tested. For this reason, beginning this task early may be advisable. All snubbers were tested at Fitzpatrick. The shop testing consisted of installing in-test stand, cycling and observing for leakage, venting during cycling, filling if necessary, then lock up pressure and bleed rate measurements.

ACTIVITY SERVICE PLAN
DW-13

1. Activity Title: Testing and Replacement of O-Rings on Personnel Air Lock
    (H) Testing and Replacement of O-Rings on Personnel Air Lock not observed
    (QC) Testing and Replacement of O-Rings on Personnel Air Lock not observed
2. Location: Personnel air lock
3. Work Description: Replace O-rings, secure inner door, test air lock, test interlock system.
    (F) Secure inner door, test air lock, test interlock system.
4. Scheduling Information: 8 hours.
    (F) 8 hours. 2 hours to set up and take down test, e.g., 2 hrs run test, 4 hrs to pressurize through 3/8" line.
    (BF) 12 hours. 24 hours elapse time.
5. Manpower
    a. Special Skills: None.
    b. Prefabrication: None.
    c. Performance: 2 mechanics
       1 test engineer
    d. Recovery: None.
6. Special Equipment/Tools: Test rig.
7. Material (spare parts, special consumables, etc.): 1 set O-rings.
    (F) 1 set O-rings. Old O-rings OK
    (BF) 1 set O-rings. New O-rings were not available.
8. Prerequisites: All personnel removed from drywell during test.
9. Procedures: SI 4.7.A.2G-1.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field:
12. Total MAN-REM:
13. Personnel Protection:
14. Remarks:
    (F) 45 psig

ACTIVITY SERVICE PLAN
DW-14

1. Activity Title: CRD Removal and Replacement
2. Location: Inside drywell in CRD gallery.
   (QC) Inside drywell in CRD gallery and Reactor Bldg.
3. Work Description: Remove and transfer to rebuild area, move from rebuild area, and replace.
   (QC) Remove and transfer to rebuild area, move from rebuild area, and replace. CRD's replacedthis outage.
4. Scheduling Information: 4 hours per CRD. This activity precludes all other work in CRD gallery. Restricted to withdrawing one rod at a time if interlocks are active.
   (H) 3 hours per CRD. This activity precludes all other work in CRD gallery. Restricted to withdrawing one rod at a time if interlocks are active.
   (QC) 6 hours per CRD. This activity precludes all other work in CRD gallery. Restricted to withdrawing one rod at a time if interlocks are active.
   (F) 2 hours per CRD. This activity precludes all other work in CRD gallery. Restricted to withdrawing one rod at a time if interlocks are active.
5. Manpower
   a. Special Skills: 1 experienced supervisor
   b. Prefabrication: Establish prerequisites; 4 mechanics, 1 supervisor, 1 HP part time, 1 operations coordinator, 2 instrument mechanics - 20 hours.
      (QC) Establish prerequisites; 6 mechanics, 1 supervisor, 1 HP part time, 1 operations coordinator, 4 instrument mechanics - 10 hours
      (F) Establish prerequisites; 4 mechanics, 1 supervisor, 1 HP part time, 1 operations coordinator, 2 instrument mechanics - 6 hours. Remove shoot out steel.
   c. Performance: 4 machinists
      1 experienced supervisor
      1 HP full time
      1 operations c-ordinator
      (F) 4 machinists
      1 experienced supervisor
      1 HP full time
      1 QC
   d. Recovery: 2 hours - 4 laborers for cleanup. Possible rework after performance of hydro.
6. Special Equipment/Tools: Unlatching tool, CRD handling hoist, CRD handling cart, lead shield, bubble suits with supplied air, machinist tool kit.
   (QC) Unlatching tool, CRD handling hoist, CRD handling cart, lead shield, supplied air, machinist tool kit.
   (BF) Unlatching tool, CRD handling hoist, CRD handling cart, lead shield, bubble suits with supplied air, machinist tool kit. Started 0800 10/6/77 (all unlatched except 2)
7. Material (spare parts, special consumables, etc.): O-ring set
   (QC) O-ring set, seal set.
   (F) O-ring set, piston seals.
   (BF) O-ring set.
   0800 10/10/77, had 5 removed and replaced.

8. Prerequisites: 1. Hold order issued for TIP drives, 2. Appropriate rod withdrawn, 3. Earthquake shield removed, 4. TIP tubing and position indicator disconnected and removed, 5. Support steel removed, 6. CRD servicing platform and associated equipment operable, 7. Reactor is in cold shutdown, 8. Communications between CRD gallery, refueling floor, and control room must be established and maintained,

   (QC) 1. Hold order issued for TIP drives, 2. Appropriate rod withdrawn, 3. Earthquake shield removed, 4. TIP tubing and position indicator disconnected and removed, 5. Support steel removed, 6. CRD servicing platform and associated equipment operable, 7. Reactor is in cold shutdown, 8. Communications between CRD gallery, refueling floor, and control room must be established and maintained, 9. Transportation path to Rebuild room established.

9. Procedures: MMI-7.
10. Periodicity: 10 percent of all CRD's removed each refueling outage.
    (F) 10 percent (14) of all CRD's removed each refueling outage.
    (QC) Only as required
11. Estimated work area radiation field: 40 mrem/hr (average rod 7-10r at inner filter location contact).
    (F) 200 mrem/hr (average rod 7-10r at inner filter location contact).
12. Total MAN-REM:
13. Personnel Protection: Bubble suits with supplied air.
    (QC) Supplied air.
14. Remarks: Should have new CRD available for installation as soon as possible. Normally performed during ISI and reactor internals work.
    (H) Should have new CRD available for installation as soon as possible. Normally performed during ISI and reactor internals work. Broke hoist cable insertion, 5th and last CRD hit on longer of 2 guide bolts by accident.
    (QC) Should have new CRD available for installation as soon as possible. Normally performed during ISI and reactor disassembly work. Only scheduled 1 per shift - no rush. Remove only those with indications of trouble.
    (BF) Field in Drywell about 150 mrem and increases by about 50 mrem when pulling a drive.

ACTIVITY SERVICE PLAN
DW-15

1. Activity Title: CRD Rebuilding
   (H) CRD Rebuilding. Spares used, rebuilt later off crit. path.
   (QC) CRD Rebuilding (done after outage was over)
2. Location: CRD Rebuilt Room
3. Work Description: Disassemble, inspect, replace O-rings, seals and bushings; reassemble; and leak test.
4. Scheduling Information: 1 hour.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 3 machinist, 1 engineer part time
      (F) 3 machinists, 1 engineer part time, 1 QC
   d. Recovery: None.
6. Special Equipment/Tools: CRD rebuild room work tables, drain tanks, storage bins, CRD rebuild tool set, nitrogen.
7. Material (spare parts, special consumables, etc.): Replacement O-rings, seals, bushings, filters.
8. Prerequisites: None.
9. Procedures: GEK 33180, GEI 92809, MMI-7.
10. Periodicity: 10 percent minimum rebuilt each refueling outage.
    (F) 14 percent minimum rebuilt after each refueling outage.
11. Estimated work area radiation field: 50 mrem/hr.
12. Total MAN-REM: 50 mrem/hr by 5 men by 3/4 hr. CRD = 0.2 MAN-REM
    (BF) Avg. dose rate per man is 40 to 50 mr/day.
13. Personnel Protection: None.
    (F) Full air masks or bubble suits.
14. Remarks: Those CRD's, which after rebuilding are intended for spares, shall be dried with nitrogen and stored.

ACTIVITY SERVICE PLAN
DW-16

1. Activity Title: Traversing In-Core Probe Servicing
   (H) Traversing In-Core Probe Servicing (not done)
2. Location: Inside Drywell - 1st and second levels.
   (QC) Inside Drywell - 1st and second levels. - outside D/W only
3. Work Description: Overhaul indexer, drive, service and/or replace tubing (see "Remarks").
   (QC) Repair drive (see "Remarks")
   (F) Overhaul indexer, drive, service and/or replace tubing (see "Remarks"). Friction test, establish core limits, op test.
4. Scheduling Information: Drive 8 hours, indexers 16 hours, tubing 48 hours.
   (QC) Drive 8 hours.
   (F) 4 drives 8 days, indexers 2 weeks/4 indexers worked together, tubing 20 hours/line, 4 hrs/ball valve
   (BF) Drive 7 da, indexers 2 wks 5 hrs, tubing 48 hours.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: Drive containment tent, if required - 2 carpenters.
      (QC)
      (F) Drive containment tent, if required - 2 carpenters. 1 I&SE.
   c. Performance: 2 mechanics
      1 HP (part time)
      (F) 1 HP (part time)
      2 I&C techs
      2 pipefitters
      (for tubing replace in lead shields & up)
   d. Recovery: None.
6. Special Equipment/Tools: Dummy probe.
   (QC)
   (F) Dummy probe - indexer to drive xxxxx must tubing - 17/64" drill cut on end of handle detectors, check welding rod (drill used pulling up into drive backwards and tying off so won't flop around
   Tubing wrenches, ball bearing - run through new tubing before installation.
7. Material (spare parts, special consumables, etc.): Tubing and fittings, standard drive, and indexer spares.
   (QC) Standard drive, and spares.
   (F) Tubing and fittings, normal drive, and indexer spares.
   37° tubing flare (used in aircraft)
   indexer test fixture (run to check clearances) that simulates drive control unit
8. Prerequisites: Hold order issued.
   (F) Hold order issued for drives.
   Build decon tent for indexers. Tag out purge sup
9. Procedures: GEK 32554, Section 4.
10. Periodicity: As required by operation.

10. Periodicity: As required by operation.
11. Estimated work area radiation field: Varies. 20 mrem/hr drywell - 200 mrem/hr in TIP room.
    (F) Varies. 50 mrem/hr drywell - 200 mrem/hr in TIP room.
12. Total MAN-REM: Varies with distribution of work.
13. Personnel Protection:
    (F) Full face masks
14. Remarks: This activity service plan is based on overhauling 1 drive, 2 indexers, and 10 percent of tubing.
    (QC) This activity service plan is based on overhauling 1 drive, 2 indexers, and 10 percent of tubing.
    Torque valve too high at one drive - vent limits and tests
    Tip tubing did not pass LLPT listing 30 SCF/n^3
    (F) This activity service plan is based on maintenance all 4 drives, all indexers, and tubing from indexers to drives on all 4 (approx 25% of total tubing).
    Elect and mech drive PM (clean, inspect adjust chain tensions and clutch.
    Note: tubing from drives to indexers used much more.
    Disassembly insp, and reasble ball valves, insp for scoring, check limit sw's.
    (BF) This activity service plan is based on overhauling 1 drive, 2 indexers, and 10 percent of tubing.
    All TIP tubing under vessel was renumbered, removed, measured and inspected. Excessive wear at bends was observed. New tubing was made up to increase bend radius. This was done in an orderly, well planned manner.
    Other TIP tubing will not be replaced, only fittings checked for proper clearance; then torque readings will be taken during pre-start up checks.

ACTIVITY SERVICE PLAN
DW-17

1. Activity Title: Recirculation Pump Motor Testing
   (F) Recirculation Pump Motor Testing. Not done
2. Location: Ground level in drywell.
3. Work Description: Perform electrical tests.
   (QC) Perform electrical tests and mechanical run-out checks.
4. Scheduling Information: 2 hours.
   (QC) 2 hours for inspection. 15 days for motor bearing replacement (no hurry)
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 2 electricians
      1 engineer part time
   (QC) 2 electricians
      1 engineer part time
      4 mechanics
      1 GE Technical Advisor
   d. Recovery: None.
6. Special Equipment/Tools:
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites: 1. Reactor shutdown
   2. Recirculation loop tagged out.
9. Procedures: DPM N75M5 and EMI-6.
10. Periodicity: Once each refueling outage.
    (QC) Once each refueling outage for inspection, repair as necessary
11. Estimated work area radiation field:
12. Total MAN-REM:
13. Personnel Protection:
14. Remarks: Perform cleaning or other corrective maintenance as required.
    (H) Perform cleaning or other corrective maintenance as required. Motor had bad runout - removing bearing to repair. GE tech. advisor on-site. Bearing repaired and replaced.

ACTIVITY SERVICE PLAN
DW-18

1. Activity Title: Remove and Replace Reactor Coolant Recirculation Pump Shaft Seals
   (F) Remove and Replace Reactor Coolant Recirculation Pump Shaft Seals (not done)
2. Location: Drywell, 1st level.
3. Work Description: Remove and replace shaft seal.
4. Scheduling Information: 24 hours.
   (H) 26 hours excluding breaks and lunches.
   (QC) 12 hr to remove and rebuild. 8 hr to replace
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 4 machinists
      1 supervisor
      1 HP part time
      (H) 4 machinists
      1 supervisor
      1 HP part time
      2 mechanics
      (QC) 4 machinists
      1 supervisor
      1 HP part time
      2 electricians (part time)
      (BF)

		Plan
(BF)	4 machinists	3
	1 supervisor	1 working superv.
	1 HP part time	1

   d. Recovery: 2 machinists - 16 hours, to rebuild seal.
      (H) 2 machinists - 16 hours, to rebuild seal. Spare seal on hand.
6. Special Equipment/Tools: Turnbuckle assembly, seal carrier fixture, spacer handling tool, 3/4-ton chain fall.
   (BF) Turnbuckle assembly, seal carrier fixture, spacer handling tool, 3/4-ton chain fall. Lock nut wrench, wagon or dolly-500 lb capacity, shaft sleeve lock plate.
7. Material (spare parts, special consumables, etc.): Spare shaft seal cartridge with O-rings.
   (BF) Spare shaft seal cartridge with O-rings. Dow Corning Silicone grease No. 55M.
8. Prerequisites: Hold orders issued, pump temperature less than 175°F.
   (BF) Hold orders issued, pump temperature less than 175°F. Tag affected system components out.
9. Procedures: MMI-9A.
   (BF) MMI-9A and MMI-9B (for rebuild of seal removed and testing)
10. Periodicity: As required.
11. Estimated work area radiation field: 100 mrem/hr.
    (H) 10 mrem/hr.
    (QC) 50 mrem/hr.

12. Total MAN-REM: 100 mrem/hr x 18 hours x 5 men = 9 MAN-REM.
    (BF) 200 mrem/hr x 18 hours x 4 men = 15 MAN-REM.
13. Personnel Protection: Provisions should be made for wetting down removed seal cartridge to prevent airborne activity.
    (H) Provisions should be made for wetting down removed seal cartridge to prevent airborne activity. This was not done.
14. Remarks: Equipment hatch near pump may be opened for more convenient access.
    (H) Equipment hatch near pump may be opened for more convenient access. Not so here. Hatch procedures require that hatch be closed. Had to remove 4-6" and a 20" I-beam for access. Rigging problems added to time consumed performing this evaluation. Insufficient manpower.
    (BF) Equipment hatch near pump may be opened for more convenient access.
    Virtually no pre-planning effort went into this work effort
    1. Tools were not gathered
    2. Parts were inconveniently located.
    3. Decision basis for doing work was not firm and on closer examination it was decided to cancel after Chattanooga (TVA) service shop crew and a vendor representative were on site trying to prepare to do the work for 3 days.

    Now, plan is to test recirc system nearer end of outage and determine need for seal replacement based on seal performance indicators during test run of pumps.

ACTIVITY SERVICE PLAN
DW-19

1. Activity Title: Main Steam Safety/Relief Valves
2. Location: Drywell, 1st and second level.
3. Work Description: Leak-test all pilots in place, remove a minimum of 50% of the valves, lift test with steam and replace (with spare valves if available).
   - (QC) Remove all of the valves, replace (with spare valves if available. Test with N_2 for main and pilot leakage.
   - (F) Remove 100% of the top works. Pilots leak tested on stand.
   - (BF) Leak-test all pilots in place, remove a minimum of 50% of the valves, lift test with steam and replace (with spare valves if available). All valves taken to Wyle and steam tested.
4. Scheduling Information: 10 hours each valve.
   - (QC) 25 days for xxx
     4 hours to remove
     4 hours to replace
     Remove and test 50% of the safety valves and replaced valves to be sent to xxxxxx for steam test.
   - (F) 24 hours each valve. (remove, steam test, replace)
5. Manpower
   - a. Special Skills: None.
   - b. Prefabrication: Remove insulation, disconnect electrically.
     2 insulators, 2 electricians.
     - (QC) Remove insulation, disconnect electrically. 2 mechanics, 2 electricians.
   - c. Performance: 6 fitters
     1 supervisor
     1 test technician
     1 HP
     3 mechanics
     - (QC) 4 fitters
       1 supervisor
       1 HP
       2 mechanics
     - (BF) 6 fitters
       1 supervisor
       4 riggers
       1 test technician
       1 HP
       3 mechanics
   - d. Recovery: Disassemble and inspect 1 of the removed valves. Test, repair as necessary, and store removed valves.
6. Special Equipment/Tools: Blank flanges, 2 torque wrenches with multipliers.
   - (F) Steam lines plugged. 2 torque wrenches with multipliers.
7. Material (spare parts, special consumables, etc.): Gaskets, O-rings, spare valves, vendor-recommended replacement parts.
   - (F) Gaskets, O-rings, spare valves, vendor-recommended replacement parts. Spare parts had to be special ordered because of many failures. (Bellows failure, pressure sw's)

8. Prerequisites: 1. Reactor in cold shutdown
   2. Hold orders issued.
   3. Blank flanges available.
   4. Main steam line plugs installed.
   5. Main steam lines drained.

   (F) 1. Reactor in cold shutdown
   2. Hold orders issued.
   3. Blank flanges available.
   4. Main steam line plugs installed.
   5. Main steam lines drained.

   Leak check air solenoids to avoid lifting during RPV hydro etc. as happened at Fitzpatrick.
9. Procedures: MMI-13.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field:
    (QC) 200 mr/hr inside D/W
    (BF) 15 mr/hr (assembly)
12. Total MAN-REM:
13. Personnel Protection:
14. Remarks:
    (H) Only pilots tested w/N_2 - OK
    (QC) 4 Valves being removed for modification work in the shops.
    (F) For MSIV's not relief valves
    (BF) 1. General removal requires 4 men 2-1/2 - 3 hrs to unbolt and remove valve from drywell. Biggest problem is lack of hoist facilities and interference from other equipment.
    2. Steam testing and rework being done on outside contract (Wyle, Huntsville)
    3. Torquing of flange bolts very slow because of space limitation - final requirements are bolt elongation (torque to 1000 ft-lbs, measure and then increase by 100 ft-lb increments until elongation is met) = 0.0135"

ACTIVITY SERVICE PLAN
DW-20

1. Activity Title: Floor Drain System Inspection and Servicing
   (F) Floor Drain System Inspection and Servicing (not done)
2. Location: Basement of drywell.
3. Work Description: Remove pump, clean intake and sump, and inspect float switches; service heat exchangers and pumps as necessary based on operational performance.
4. Scheduling Information: 16 hours. CRD work or other work that causes leakage may interfere with this activity.
   (BF) See below - 5.c. CRD work or other work that causes leakage may interfere with this activity.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 2 mechanics
      1 HP
      1 electrician part time
      1 supervisor part time
   (BF) 2 machinists 1 hr/pump
      1 HP
      2 electricians part time, 45 min/pump
      1 supervisor part time
      3 fitters, 1 hr/pump remove and replace
      2 laborers for clean-up
      30 min. for "dress out"
      Total: 3-1/2 hours/pump
6. Special Equipment/Tools: None.
7. Material (spare parts, special consumables, etc.): Vendor-recommended spare parts.
   (BF) Vendor-recommended spare parts. Spare impeller was on hand.
8. Prerequisites: 1. Drywell entry established.
   (BF) 1. Drywell entry established.
      CRD work was completed prior to this work - schedule not critical.
9. Procedures: Vendors manual
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field:
   (BF) 40 mr/hr
12. Total MAN-REM:
13. Personnel Protection:
   (BF) 2 pr. coveralls, full mask and hoods taped to mask.
14. Remarks:
   (F) No work performed this outage.
   (BF) Other than location restrictions this was a simple task for the various crafts.

ACTIVITY SERVICE PLAN
DW-21

1. Activity Title: Integrated Leak Rate Test
   (H) Integrated Leak Rate Test not done
   (QC) Integrated Leak Rate Test not done
   (F) Integrated Leak Rate Test not done
   (BF) Integrated Leak Rate Test (not due to be done this outage)
2. Location: Reactor building.
3. Work Description: Pressurize primary containment, monitor for leakage.
   (BF) Pressurize primary containment, monitor for leakage. Leak Rate Test between drywell and suppression pool was conducted. 21 hrs elapsed time.
4. Scheduling Information: 96 hours.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 5 test engineers
      4 mechanics
   d. Recovery: None.
6. Special Equipment/Tools: Test rig.
7. Material (spare parts, special consumables, etc.): None.
8. Prerequisites:
   1. Vessel head removed or vessel properly vented.
   2. Normal operational water level and proper valve lineup established.
   3. Test equipment installed in the drywell.
   4. Required LLRT's performed.
   5. Hatches between drywell and reactor cavity must be opened.
   6. Drywell head on, drywell closed and sealed, personnel evacuated.
9. Procedures: SI 4.7.A.2
10. Periodicity: Once every 40 months.
11. Estimated work area radiation field:
12. Total MAN-REM:
13. Personnel Protection:
14. Remarks:

ACTIVITY SERVICE PLAN
DW-22

1. Activity Title: Drywell Exit Inspection and Resilient Seal Testing
2. Location: Inside drywell and ground level Reactor Building.
3. Work Description: Test resilient seals, repair as required, visually inspect drywell for operational readiness.
4. Scheduling Information: 60 hours. Work in parallel with other drywell work. Approximately 8 hours of critical path. Schedule seal testing early in the outage in event repairs are required.
   (QC) 60 hours. Work in parallel with other drywell work. Approximately 8 hours of critical path.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 2 test engineers
      2 mechanics.
      Requires support by laborers and carpenters (one crew each).
   d. Recovery: None.
6. Special Equipment/Tools: Test rig.
7. Material (spare parts, special consumables, etc.): Replacement O-rings.
8. Prerequisites: None.
9. Procedures: SI 4.7.A.2.G-3.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field:
    (QC) 15 mr/hr
12. Total MAN-REM:
    (QC) 300 man rem
13. Personnel Protection:
    (QC) As required
14. Remarks:
    (QC) 1. Test of resilient seals should begin early in the outage. Only torus latches, personnel air lock and possibly equipment hatches should remain near the end of the outage.
    (F) 8 large valves vent and purge.

ACTIVITY SERVICE PLAN
DW-23

1. Activity Title: Inspect and Service Drywell Cooling Units
2. Location: Inside drywell.
3. Work Description: Perform general inspection (both with units operating and while shut down), perform electrical test, repair as necessary.
4. Scheduling Information: Inspection - 4 hours/unit
   Repairs - as required
   (QC) Inspection - 1 hour/unit
   Repairs - as required
   (F) Inspection - 4 hours/unit
   Repairs - as required
   Motor replacement ≈ 4 days
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 2 electricians
      2 mechanics
      1 inspector
      (F) 2 electricians
      2 mechanics
      1 inspector
      Operators inspect and grease. Mechanics called for repairs only.
   d. Recovery: None.
6. Special Equipment/Tools: None.
7. Material (spare parts, special consumables, etc.): Spare blower motor or spare parts.
8. Prerequisites: Drywell entry.
9. Procedures: None.
   (BF) Perhaps a procedure should be written. Although the units were operated and checked out electrically, a bad bearing was not discovered until the fan was rotated by hand during a blade adjustment procedure.
10. Periodicity: Once each refueling.
11. Estimated work area radiation field:
12. Total MAN-REM:
13. Personnel Protection:
14. Remarks:
   (QC) No repair req'd.
   (F) DW temperature increased about 5°F while one cooler was out of service. No GAME

ACTIVITY SERVICE PLAN
DW-24

1. Activity Title: Safety Relief Valve Air supply testing and Servicing.
   (QC) Safety Relief Valve Air supply testing and Servicing.
   Not done.
   (F) Safety Relief Valve Air supply testing and Servicing.
   Not done.
2. Location: Inside drywell.
3. Work Description: Test operation of each instrument air supply, check valve and accumulator, replace or repair as necessary.
4. Scheduling Information: Testing 4 hours, Repair - 4 hours/valve.
   (BF) Testing 8 hours, Repair - 4 hours/valve.
5. Manpower
   a. Special Skills: None.
   b. Prefabrication: None.
   c. Performance: 1 test engineer part time
      4 mechanics
      1 supervisor part time
   d. Recovery: None.
6. Special Equipment/Tools: Pressure gauge.
7. Material (spare parts, special consumables, etc.): Spare check valve, spare filter elements, O-rings.
   (BF) Spare check valve, spare filter elements, O-rings.
   Spare check valves* were not available but turned out that they were not needed.
8. Prerequisites: 1. Unit in cold shutdown.
   2. Pressure switch (in line) calibrated.
   3. Pressure gauge calibrated.
9. Procedures: MMI-42.
10. Periodicity: Once each refueling outage.
11. Estimated work area radiation field:
12. Total MAN-REM:
13. Personnal Protection:
14. Remarks: 1. All SRV's tested simultaneously.
    2. Test requires service air system in the drywell be isolated and vented.
    3. Drywell cooling dampers, MSIV air, etc.
    (BF) 1. All SRV's tested simultaneously. 6 ADS valves.
    2. Test requires instr. air system in the drywell be isolated and vented.
    3. Drywell cooling dampers, MSIV air, etc.
    Test itself did not take long. Getting air supply lined-up, etc., took most of the time.
    1. ADS accumulator check valves were tested night shift 12/7/77
    Valves checked OK.

*The spare valves were at warehouse but not put in stock and paperwork completed.