U. S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-255/93017(DRP)

Docket No. 50-255 License No. DPR-20

Licensee: Consumers Power Company
212 West Michigan Avenue
Jackson, MI 49201

Facility Name: Palisades Nuclear Generating Plant

Inspection At: Palisades Site, Covert, Michigan

Inspection Conducted: June 29 through August 12, 1993

Inspectors: M. E. Parker T. Tella
D. G. Passehl M. D. Gamberoni
A. W. Markley

Approved By: _____ 8-26-93
B. L. Jorgensen, Chief Date
Reactor Projects Section 2A

Inspection Summary

Inspection from June 29 through August 12, 1993
(Report No. 50-255/93017(DRP))
Areas Inspected: Routine unannounced inspection by the resident inspectors of actions on previously identified items, licensee event report followup, followup of events, operational safety verification, radiological controls, maintenance, surveillance, quality program activities, and management meeting. No Safety Issues Management System (SIMS) items were reviewed.

Results: No cited violations or deviations were identified in any of the ten areas inspected.

The strengths, weaknesses, and Inspection Followup Items are discussed in paragraph 1, "Management Interview."

DETAILS

1. Management Interview (71707)

The inspectors met with licensee representatives (denoted in paragraph 11) on August 19, 1993, and informally throughout the inspection period and summarized the scope and findings of the inspection activities. The inspectors also discussed the likely informational content of the inspection report including the attachment, with regard to documents or processes reviewed by the inspectors. The licensee did not identify any such documents or processes as proprietary.

Highlights of the management interview are discussed below:

a. Strengths noted:

(1) Management control of briefings. Infrequent evolution, pre-evolution, and pre-job briefings were well attended and coordinated (paragraph 8).

(2) Control of surveillance testing. Several engineered safeguards actuation signals were generated during the previous refueling outage. Significant progress was made since then in improved procedures and in engineering oversight of surveillance activities (paragraph 8).

b. Weaknesses noted:

(1) Failure to keep the control room informed on significant potential concerns (paragraph 4.b).

(2) Design control. An inappropriate modification was performed on a safeguards bus breaker utilizing a work order (paragraph 4.a).

c. An unresolved item pertaining to design control was discussed (paragraph 4.a).

d. An Unusual Event relating to the lifting of a fuel assembly with the upper guide structure occurred (paragraph 5.c).

2. Actions on Previously Identified Items (92701, 92702)

a. (Closed) Violation 255/87027-01A: Failure to implement timely corrective action for a previously identified NRC item regarding operability requirements of charging pumps.

The operating procedures, the FSAR, and Technical Specifications were not consistent for several months. The licensee's response (dated January 28, 1988) explained how the previously identified NRC item was erroneously closed internally. The revised FSAR

Section 9.10.2.6 describes the current functions of the charging pumps and is consistent with the Technical Specifications.

The licensee also issued a Licensee Event Report (LER No.87-039) to address the operability question of charging pump P-55B. As a part of the corrective actions indicated in the LER, the licensee completed a modification which allows charging pump P-55B to be powered from either diesel generator 1-1 or 1-2.

The licensee also performed an analysis for the Main Steam Line Break (MSLB) event, for which no credit was taken for the charging pump flows. Based on the licensee's response and the corrective actions taken, this item is considered closed.

b. (Closed) Violation 255/87027-01B: Failure to implement timely corrective action to control contractor activities.

Several events, including a temporary loss of shutdown cooling, occurred due to improper installation of jumpers by a vendor. The licensee's response (dated January 28, 1988) to the violation stated that the cause for the events was inadequate pre-job planning/reviews. Corrective actions were taken to remove all jumpers installed by the vendor and to require that the job plans be reviewed by an electrical engineer.

The licensee issued administrative procedure No. 5.17, "Training and Qualification for Nonpermanent Plant Employees and Contracted Services Personnel," Revision 2. The licensee stated that this procedure is being implemented for all contractors. The inspectors were informed by the Service Coordinator in the maintenance department that contractors presently work in accordance with plant procedures and are always accompanied by plant personnel.

The actual work, such as installation of jumpers, will be done by plant technicians in accordance with plant administrative procedure No. 5.16, "Control of Jumpers, Leads and Links During Maintenance, Modifications, and Testing" (Revision 1), and No. 9.31, "Temporary Modification Control" (Revision 7). Based on the response to the violation and the corrective actions taken, this item is considered closed.

No violations, deviations, unresolved, or inspection followup items were identified in this area.

3. Licensee Event Report Followup (92700, 92720)

The inspector reviewed the following Licensee Event Report (LER) by means of direct observation, discussions with licensee personnel, and review of records. The review addressed compliance to reporting requirements and, as applicable, that immediate corrective action and appropriate action to prevent recurrence had been accomplished.

(Closed) LER 255/91010: Emergency Diesel Generator (DG) unanticipated start during the performance of Special Test T-297, "DG 1-1 Load Reject": On February 24, 1991, with the plant in cold shutdown, an unanticipated start of DG 1-2 occurred during the performance of Special Test T-297. At the time of the test, electrical bus 1C was being powered by DG 1-1 with a load of approximately 1100 kW. Auxiliary feedwater pump P-8A was started as required. Immediately after the start of P-8A a voltage drop occurred causing instrument bus Y-01 to transfer to its emergency power source, i.e. from MCC-1 to MCC-2. Also, DG 1-2 started and load shedding did not occur.

The final electrical load on bus 1C following the event was approximately 1400 kW. In addition to the above events, the following plant responses were also observed:

- MO-2087, "volume control tank (VCT) outlet" closed, apparently due to a lo-lo level signal generated during the Y-01 transfer.
- MO-2160, "safety injection and refueling water (SIRW) to charging pumps" remained closed.
- With charging pumps P-55B and P-55C operating prior to the test, P-55B tripped, apparently on low suction pressure; however, P-55C continued to operate. The control room operator re-opened MO-2087 to restore the suction path to the charging pumps.

In an effort to determine the root cause of the observed plant responses, the same test conditions were re-established to allow data gathering. One exception to the previous conditions was that the DG 1-2 was started prior to the beginning to the test.

The licensee's evaluation of the test results reached the following conclusions:

a. The undervoltage condition should have been expected when starting an auxiliary feedwater pump on DG 1-1 since it was already carrying significant load. The examination of the relaying scheme found that voltage dipped low enough so that DG 1-2 would have started as designed. However, voltage did not dip low enough to energize the load shed relays for DG 1-1.

b. The instrument bus Y-01 transferred as designed from its normal source to its emergency source upon sensing an undervoltage. Since the relaying scheme is a make-before-break operation, the Y-01 bus experienced a momentary voltage degradation and transferred as designed.

c. Although MO-2160 did not open, the licensee found the transfer of Y-01 was fast enough to energize the breaker operating coil of MO-2087 but not MO-2160. The licensee replaced the relay that actuates the breaker coils of these two motor-operated valves such

that the suction source of the charging pumps would not change on a transfer of power sources to Y-01.

d. The low suction pressure trip setpoints and time delays for charging pumps P-55B and P-55C were checked. The licensee could not find a definitive reason for P-55C not tripping. A possible reason was that MO-2087 closed, shutting off suction to the charging pumps. Both pumps continued running drawing residual water from the suction header; the low suction pressure setpoint for P-55B was reached and the pump tripped as designed. MO-2087 was reopened before the low suction pressure trip for P-55C was reached.

The licensee's corrective and preventive actions included revising the two special electrical test procedures to eliminate unwanted DG starts. They also reviewed all other similar type relays on Y-01 and found no further problems.

No violations, deviations, unresolved, or inspection followup items were identified in this area.

4. Followup of Events (93702)

During the inspection period, the licensee experienced several events, some of which required prompt notification of the NRC pursuant to 10 CFR 50.72. The inspectors pursued the events onsite with licensee and/or other NRC officials. In each case, the inspectors verified that the notification (if required) was correct and timely, that activities were conducted within regulatory requirements, and that corrective actions would prevent future recurrence. The specific events are as follows:

June 28, 1993	Fuel fragments were discovered in the reactor cavity tilt pit (see paragraphs 5.b. and 6 for further details).
July 6, 1993	An Unusual Event was declared as a result of a fuel assembly being lifted with the upper guide structure (see paragraph 5.c for further details).
July 20, 1993	An Engineered Safety Features Actuation occurred; both emergency diesel generators automatically started on an undervoltage signal.
August 4, 1993	A fuel rod disengaged from the fuel rod grappler during insertion into a fuel assembly.
August 6, 1993	A remote radiation detector cable was severed in the reactor cavity tilt pit.

a. On July 20, 1993, both emergency diesel generators (DGs) automatically started on an undervoltage condition on a

safeguards bus. The licensee was in the process of installing a spare feeder breaker into breaker cubicle "152-106," (startup transformer to safeguards bus "1C") when feeder breaker "152-105" (station power transformer to safeguards bus "1C") sensed that another power supply was being loaded onto the bus and tripped open per design.

This resulted in an undervoltage condition on the bus and auto-start of both DG's. As bus "1C" had an undervoltage condition due to the shedding of its power supply, DG 1-1 started and loaded on the bus. However, bus "1D" was still being supplied by its normal power supply 152-203, (Station power transformer to safeguards bus "1C") and, therefore, DG 1-2 ran unloaded.

The licensee took action to completely remove the spare breaker from cubicle 152-106, inspect breaker 152-105, and restore normal power to bus "1C" by reclosing 152-105 onto bus "1C." Upon restoring normal power to the bus, DG 1-1 was secured and returned to normal standby condition.

In reviewing the ESF actuation with the licensee, the inspector determined that the cause for the breaker (152-106) tripping open was a modification performed to the spare breaker. On July 9, 1993, the spare breaker that was inserted into position 152-106 had been modified to replace the normally open contact on the auxiliary transfer scheme with a normally closed contact. Thus when 152-106 was moved into its cubicle beyond the disconnect position towards the test position, the normally closed contact resulted in breaker transfer circuitry actuating to open breaker 152-105.

This action is per system design to prevent paralleling two sources of ac power out of synchronization. Further review identified that this modification was performed under a work order (No. 24203314) versus a formal design change, thus not receiving a formal design review. This was previously addressed as an unresolved item (50-255/93013-02 (DRS)) in inspection report No. 50-255/93013. This item will remain unresolved pending further review by both the licensee and the NRC into the circumstances surrounding the breaker modification.

b. On August 4, 1993, a fuel rod became disengaged from the fuel rod grappling tool. At the time of the incident, the licensee was in the process of reconstituting "L" bundles. These "L" bundles are proposed replacements for the "I" bundles. The "L" bundles are being reconstituted with 14 stainless steel rods in peripheral locations. This entails exchanging stainless steel rods from one assembly, with fuel rods from another assembly. At the time the fuel rod became

disengaged, the licensee was transferring a fuel rod from fuel assembly "L-18" to fuel assembly "H-38."

The fuel rod was approximately halfway inserted into assembly "H-38," when the rod became disengaged. The rod fully dropped into position in the fuel bundle. The crew's immediate actions included confirming no release of airborne radio activity occurred, stopping all further fuel moves, confirming the fuel rod was fully seated, and inspecting the fuel grappler.

The inspector's followup of this incident indicated that the control room/shift supervisor was not aware of it for over two hours after the incident occurred. In addition, plant management was not informed until the next day. Although first line supervision was aware of the dropped pin and was proposing steps to resume work, those individuals assigned emergency responsibilities (specifically the shift supervisor) were not informed of this incident in a timely manner.

The inspectors discussed this incident with plant management to ensure adequate steps were being taken to provide for timely notification of the appropriate individuals.

c. On August 6, 1993, the licensee was attempting to retrieve a piece of fuel rod fragment and transfer it to a specially designed can in the fuel transfer carriage. A remote radiation detector was suspended in the reactor cavity tilt pit. During rotation of the fuel transfer carriage from the reactor side to the fuel pool side in support of the fuel fragment recovery, the detector cable was severed.

The licensee immediately stopped all work in the tilt pit area. The shift supervisor was immediately notified. The licensee issued a deviation report and held a Corrective Action Review Board (CARB). As part of the CARB corrective action, the licensee secured all further fuel rod fragment recovery efforts, ensured the grappled fuel rod fragment was in a safe recoverable position, took action to locate the severed detector, and initiated action to ensure all crews were briefed on this incident. The licensee subsequently recovered the detector on August 9, 1993.

One unresolved item was identified. No violations or deviations were identified in this area.

5. Operational Safety Verification (71707, 71710, 42700)

Routine facility operating activities were observed as conducted in the plant and from the main control room. Plant startup, steady power

operation, plant shutdown, and system(s) lineup and operation were observed as applicable.

The performance of reactor operators and senior reactor operators, shift engineers, and auxiliary equipment operators was observed and evaluated. Included in the review were procedure use and adherence, records and logs, communications, shift/duty turnover, and the degree of professionalism of control room activities.

Evaluation, corrective action, and response for off normal conditions were examined. This included compliance to any reporting requirements.

Observations of the control room monitors, indicators, and recorders were made to verify the operability of emergency systems, radiation monitoring systems, and nuclear reactor protection systems. Reviews of surveillance, equipment condition, and tagout logs were conducted. Proper return to service of selected components was verified.

Periodic verification of Engineered Safety Features status was conducted by the inspectors. Equipment alignment was verified against plant procedures and drawings and detailed walkdowns selectively verified: equipment labeling, the absence of leaks, housekeeping, calibration dates, operability of support systems, and breaker and switch alignment, as appropriate.

a. General

The plant continued with the refueling outage that began June 4, 1993.

b. Fuel Pieces Discovered In Reactor Cavity Tilt Pit

On June 30, 1993, while draining the refueling cavity following core refueling, several pieces of a fuel rod were identified in the reactor cavity tilt pit. Dose measurements were 6000 to 8000 R/hr on contact and 200 R/hr at 12 inches. The licensee stopped all work activities associated with resetting the vessel head and mobilized a team to lower a camera into the reactor cavity tilt pit and record the visual inspection. Later in the day the inspector accompanied a health physics technician to verify that dose rates in the general area on the refueling deck were only slightly elevated above background.

A total of four fuel pieces were identified and traced to fuel assembly I-24, located at core location B-19. During the current refueling outage, fuel assembly I-24 was removed from the core, placed in the reactor cavity tilt pit, rotated 180 degrees, and placed back into the core. This fuel assembly had been in the core during five previous fuel cycles and was placed on the periphery of the core to shield the reactor vessel belt welds. The integrity of I-24 was verified by ultrasonic inspection during the previous refueling outage.

The licensee concluded that the fuel pin split during the previous fuel cycle and fell out of the fuel assembly while it was placed in the reactor cavity tilt pit upender for the 180 degree rotation. On July 4, 1993, the fuel pin pieces were retrieved and placed in an appropriate storage container and later moved to the spent fuel pool. The mechanism that caused the pin to separate from the fuel assembly was still under evaluation at the end of the inspection period. See paragraph 6 for further details.

c. Fuel Assembly Lifted With Upper Guide Structure

Plant operators declared an Unusual Event at 10:54 p.m. (EDT) on July 6, 1993. The cause of the declaration was lifting of a fuel assembly, SAN-8, from the reactor core with the lifting of the upper guide structure. The fuel assembly was lifted from core location Z-11 and remained firmly attached to the bottom of the upper guide structure during the lift. The upper guide structure had been lifted about three feet at the time the attached fuel assembly was discovered.

The licensee secured the lift, evacuated unnecessary containment personnel, closed the equipment hatch, and convened a meeting in the Technical Support Center (TSC) to determine a course of action. The inspector had been onsite observing the lift and immediately notified senior Region III and NRR management personnel to apprise them of the situation.

The licensee assured that the fuel assembly would not drop by attaching two wire slings to the grappling lugs of the fuel assembly upper tie plate. On Thursday July 8, 1993, a tool was manufactured to apply a downward force on the grappling lugs. The fuel assembly was detached from the upper guide structure by applying the downward force. The fuel assembly was then lowered into the core, and the upper guide structure was removed from the reactor vessel and placed on its storage stand. The Unusual Event was terminated at 4:50 p.m. (EDT) on July 8, 1993.

This was the second time during the current refueling outage that the upper guide structure was removed from the reactor vessel. The first removal occurred without incident and was performed to allow for routine fuel shuffling. The stuck fuel assembly was in the same core location during the past fuel cycle; it was removed, rotated 180 degrees, and replaced during the fuel shuffling. The second upper guide structure lift was to support inspection of the damaged fuel assembly I-24 as described earlier.

Also, this was the third time that a fuel assembly remained attached to the upper guide structure during its removal. The previous events occurred in 1988 and 1992. During all three events, the fuel assembly lifted was from the same core location, Z-11.

d. Augmented Inspection Team (AIT) dispatched

On July 8, 1993, an AIT was dispatched to Palisades to investigate the problems described in paragraphs 5.b. and 5.c. above. The team charter was approved on July 8, 1993.

A Confirmatory Action Letter outlining the licensee's action to recover the stuck fuel assembly and to establish root causes for this and several recent events described in recent NRC inspection reports was also approved on July 8, 1993.

The AIT conducted a public management interview with the licensee on Tuesday July 20, 1993. The AIT will document their findings in inspection report No. 50-255/93018 (DRP).

Following the conclusion of the AIT, regional and headquarters management and inspectors continued to hold daily conference calls with the licensee to discuss their progress in identifying the root cause of the fuel failure and the inadvertent lifting of a fuel bundle. In addition, the licensee presented their new evaluation methods for detecting future fuel failures, and the results of their fuel inventory accountability effort. The daily discussion topics are included as Attachment 1 to this report.

No violations, deviations, unresolved or inspection followup items were identified in this area.

6. Radiological Controls (71707)

a. Routine Inspection

During routine tours of radiologically controlled plant facilities or areas, the inspector observed occupational radiation safety practices by the radiation protection staff and other workers.

Effluent releases were routinely checked, including examination of on-line recorder traces and proper operation of automatic monitoring equipment.

Independent surveys were performed in various radiologically controlled areas.

b. Reactive Inspection

On June 28, 1993, a fuel fragment was discovered in the reactor cavity near the reactor vessel. This fragment had a contact dose rate reading of 900 Rem/hr (9 Sv/hr) and a reading of 12 Rem/hr (0.12 Sv/hr) at 12 inches from the fragment. On June 30, 1993, a highly activated object approximately five feet long was found at the bottom of the reactor cavity tilt pit. This object had indicated dose rates of 6,000 - 8,000 Rem/hr (60-80 Sv/hr) near contact. Subsequent investigation determined that this object was

a fuel rod from assembly I-24 and that there were two additional fuel rod fragments that varied in size from one and a half to four feet in length. The inspector reviewed licensee actions related to evaluation and safe recovery of these highly radioactive objects.

i. Licensee Radiological Response

The licensee's response and handling of both the fuel fragment and the broken fuel rod were conducted such that reasonable precautions, planning methods and dose minimizing techniques (that precluded an inadvertent radiation exposure) were employed. These included pre-job briefings, discussions of task, remote handling tools, shielding, and a cask to deal with the fuel fragment. Similar techniques were also utilized in response to the fuel rod and subsequent evaluation thereof.

ii. Licensee Evaluation Efforts

The licensee became aware of abnormal coolant radio chemistry conditions during the December 1992 to January 1993 time frame. A continuous trend of an increasing concentration of Dose Equivalent Iodine-131 (DEI-131) was noted in the primary codant sampling results. However, normal evidence of a leaking fuel rod was not apparent. There were no iodine spikes.

The licensee explored several theories as to the cause of this condition. One theory held that the increasing iodine resulted from previous fuel leakers with a pellet fragment lodged in a spacer grid. Another theory held that because of previous fuel leaks, especially the Cycle 9 fuel (five leakers), there may have been sufficient "tramp uranium" in the coolant system to come out of solution later in the fuel cycle. The "tramp uranium" concept held that uranium would come out of solution when lithium became the driving force for pH control late in the fuel cycle.

In an effort to identify the source of the DEI-131, the licensee performed two "hard" shutdowns (power reduction at a rate of approximately 24 percent per hour) to observe possible iodine concentration spikes. The first was done at the end of April 1993 for a forced outage. The second hard shutdown occurred at the beginning of June 1993 for the scheduled refueling outage. However, no iodine spikes were observed.

Additional data became available during the forced shutdown as well as early during the refueling outage. As identified by the licensee, air samples began to show fission products and alpha contamination. Whole body counts for radiological

workers also began to indicate an uptake of fission products. Additionally, smears taken inside the primary system identified fission products and alpha contamination. Early in the refueling outage several personnel contaminations found fission product particles (fuel particles).

The only effort observed to date by the licensee to evaluate the source of these fission product/fuel particles resulted from the evaluation performed by the reactor engineering group. An evaluation of the cesium-134 to cesium-137 ratios (approximately 0.1 - which indicated approximately 2500 MWD/MTU burn-up) indicated that the fuel fragment may have originated from the Cycle 9 fuel. However, no other instances of fuel particle aging were provided. With the exception of the reactor engineering group, the remainder of the licensee's staff appeared to have limited cognizance of fuel particle aging methodologies, i.e., cesium and cerium ratios.

iii. Licensee Use of Data

The licensee had sufficient data from DEI-131 chemistry sampling results to indicate that there was fuel in the primary coolant system. Further evidence of fuel in the primary system was identified by the licensee. Radiological surveys identified findings of fission products and alpha contamination and whole body counts identified fission products from the forced outage that occurred during the late April to mid-May 1993 time frame. Confirmatory data was also identified in the radiological surveys performed during the refueling outage that began in early June 1993. Isotopic analyses of hot particles from several personnel contamination events identified fission products and transuranics.

Interviews with licensee operations, radiological safety, chemistry, and reactor engineering management and technical personnel indicated there was a general awareness of the potential for fuel in the primary system. However, the licensee's focus was on familiar fuel leakers associated with failed cladding and associated gap release into the primary coolant system. The licensee considered the discovery of the hot fuel fragment that read approximately 900 Rem/hr (0.12 Sv/hr) to be an isolated incident.

The licensee was questioned as to their pre-outage plans for radiologically dealing with fuel particles and alpha contamination. The licensee indicated that more frequent counts were being performed for alpha contamination. Plans

and controls for addressing radiological control of fuel particles were planned for after the current refueling outage.

This topic was reviewed further by the NRC Augmented Inspection Team (AIT) which was sent to the plant during this inspection period. The AIT findings are documented in NRC Inspection Report 050-255/93018(DRP).

No violations, deviations, unresolved or inspection followup items were identified in this area.

7. Maintenance (62703, 42700)

Maintenance activities in the plant were routinely inspected, including both corrective maintenance (repairs) and preventive maintenance. Mechanical, electrical, and instrument and control group maintenance activities were included as available.

The focus of the inspection was to assure the maintenance activities reviewed were conducted in accordance with approved procedures, regulatory guides and industry codes or standards, and in conformance with Technical Specifications. The following items were considered during this review: the Limiting Conditions for Operation were met while components or systems were removed from service; approvals were obtained prior to initiating the work; activities were accomplished using approved procedures; and post maintenance testing was performed as applicable.

During a tour of the plant with the regional management, several work request (WR) tags were observed for components in the diesel generator (DG) rooms. Some of the WR tags were a few months to several years old. The status of the work requests was checked since maintenance outages were just completed on each of the DGs, and it appeared the licensee missed an opportunity to perform the work. In some instances the work was performed but the WR tags were not removed. One WR required an engineering evaluation for use of a new valve, but this took about three and a half years to process. It appears the licensee could do a better job of controlling the work backlog.

The WR tags found on DG 1-1 were:

a. WR 17613 initiated July 13, 1992 - "P-905A (prelube oil priming pump) and lube oil heater are leaking oil onto floor." A new mechanical seal for the pump arrived onsite July 16, 1993. This WR is scheduled to be worked during the next scheduled maintenance outage.

b. WR 139306 initiated April 18, 1991 - "TS-1477 Temperature element is leaking." The leak was repaired (date unknown) but the WR tag was not removed. A separate issue remains regarding adequacy of the depth of the well for the temperature sensor. This issue was

assigned to engineering to resolve, but they had no separate documentation for tracking resolution of this apparent new issue. A responsible engineer stated he would use the above WR number to track this item, and that it will be addressed during the next scheduled maintenance outage on the DG.

The WR tags found on DG 1-2 were:

a. WR 243181 initiated February 19, 1993 - "K-6B; 2 1/2 inch pipe plug shows indication of oil leakage." This work request was not found in records kept by the maintenance department. It was reassigned a new WR number (19525) and given to a maintenance planner to plan the work for the next scheduled maintenance outage on the DG.

b. WR 128539 initiated August 10, 1989 - "K-6B; MV-DE666 (differential pressure gauge isolation valve for a lube oil strainer) - oil leaks out of valve onto floor." This WR had been awaiting an engineering evaluation for a new valve since the WR was initiated. The evaluation was completed on February 15, 1993, yet work to replace the valve was not performed during the recent maintenance outage due to an oversight. The maintenance planner stated he would plan the work for the next scheduled DG maintenance outage.

c. WR 133024 initiated September 28, 1992 - "K-6B; lube oil alarm coming in intermittently." The maintenance planner stated this was originally scheduled for work in April 1993 but was missed and never re-scheduled. The maintenance planner stated this will be scheduled for the next DG outage.

d. WR 256789 initiated November 10, 1990 - "K-6B; pump discharge pressure too low to activate pressure switch PS-1487." The pressure switch reportedly works satisfactorily, and the WR tag should have been removed.

No violations, deviations, unresolved, or inspection followup items were identified in this area.

8. Surveillance (61726, 42700)

The inspector reviewed technical specifications required surveillance testing as described below, and verified that testing was performed in accordance with adequate procedures. Additionally, test instrumentation was calibrated, limiting conditions for operation were met, removal and restoration of the affected components were properly accomplished, and test results conformed with technical specifications and procedure requirements. The results were reviewed by personnel other than the individual directing the test, and deficiencies identified during the testing were properly reviewed and resolved by appropriate management personnel.

The inspector attended the pre-job briefing for the following two infrequently performed surveillance tests. The briefings were well coordinated and comprehensive. The operations superintendent was present, as was the system engineering department manager. The operations superintendent explained management's expectations on procedure adherence and communications. Identification and staging of key players and equipment were accomplished. The procedure walkthrough was thorough and well performed.

The inspector also observed mini-briefs throughout the evolution between smaller numbers of individuals. A mini-brief among several operators and their shift supervisor was very effective, with better two-way communication than the major briefing. This was probably due to the inherent difficulty of establishing an effective two-way communication with a large diverse group of individuals.

a. RT-13A, "Normal Shutdown Sequencer Test - Left Channel"

This was successfully completed, but two deficiency reports (DRs) were issued. One DR was written because a breaker switch for a ventilation unit in the control room heating, ventilation, and air conditioning system was not in its proper pre-test lineup. The other DR was written when several breakers would not close due to interference from the data acquisition system (DAS). The licensee satisfactorily resolved both problems.

b. RT-8C, "Engineered Safeguards System - Left Channel"

This test was performed in two parts - safety injection system (SIS) actuation without offsite power available and SIS actuation with offsite power available.

Two problems occurred with this test. One involved the DAS being connected in such a way that the software would not accept the data. Fortunately, the licensee was able to retrieve the data.

The second problem was that the "A" auxiliary feedwater pump breaker closed about 1 millisecond beyond its acceptable time. The licensee performed an engineering analysis that determined this was acceptable.

No violations, deviations, unresolved, or inspection followup items were identified in this area.

9. Quality Program Activities (37701, 38702, 40704, 92720)

The effectiveness of management controls, verification and oversight activities, in the conduct of jobs observed during this inspection, was evaluated.

The inspector frequently attended management and supervisory meetings pertaining to plant status and plans which focused on proper co-ordination among departments.

The results of licensee auditing and corrective action programs were routinely monitored by attendance at Corrective Action Review Board (CARB) meetings; and by review of Deviation Reports, Event Reports, Radiological Deficiency Reports, and Security Deficiency Reports. As applicable, corrective action program documents were forwarded to NRC Region III technical specialists for information and possible followup evaluation.

The inspector attended the licensee's Independent Safety Review (ISR) Meeting conducted on May 24 and 25, 1993, at the Big Rock Point Nuclear Power Plant. The meeting covered topics relevant to both Big Rock Point and Palisades. The inspector reviewed the procedures, reports and personnel qualifications applicable to the ISR function, and also interviewed members of the Nuclear Performance Assessment Department.

The inspector found that the ISR personnel were qualified and met the experience requirements of ANSI/ANS 3.1, "Selection, Training, and Qualification of Personnel for Nuclear Power Plants." The members of the ISR group in attendance constituted a quorum as defined in the Technical Specifications. The licensee's procedures were found to meet the standards described in ANSI N18.7, "Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants." Meeting minutes met the intent of ANSI N18.7 for timely dissemination and identification of material reviewed.

Concerns expressed by the ISR group generally appeared to be effectively resolved. There appeared to be some uncertainty as to the status of a few overdue open items. But the majority of the backlog items identified during the past year seem to have been resolved.

a. Members

The licensee's Independent Safety Review (ISR) group consists of the Nuclear Performance Assessment Department (NPAD) Director, a Performance Trending and Analysis Supervisor, and seven Nuclear Performance Specialists. This exceeds the guidance of ANSI N18.7, which states that the independent review and audit group should have a minimum of five members.

b. Individual Qualifications

Palisades Technical Specification (TS) 6.5.2 and Big Rock Point TS 6.5.2 state that the Director and Nuclear Performance Specialists shall meet the requirements of ANSI/ANS 3.1, Selection, Training and Qualification of Personnel for Nuclear Power Plants, Section 4.7 Independent Review Personnel. American National Standard 3.1

requires the independent review group to have members qualified in the appropriate fields associated with the normal and unique characteristic of the nuclear power plant.

In addition, members performing reviews of the operational phase activities listed in ANSI/ANS 3.1, shall have a bachelors degree in engineering or a related science and a minimum of 5 years professional level experience in an area related to nuclear power plant operations.

The chairman of the ISR group shall have a bachelors degree in engineering or a related science and a minimum of 6 years professional level managerial experience in the power field.

The ISR personnel qualifications were reviewed. Each of the members has extensive experience and all areas required by ANSI 3.1 are covered by qualified individuals. There are no designated alternates; the specialists back-up each other. If an area being reviewed and discussed requires a particular specialist to be present, the discussion is scheduled based on the specialist's availability.

Although Big Rock Point and Palisades TS provide the authority to utilize consultants, the licensee's ISR does not utilize them.

c. Procedures and Process

Nuclear Performance Assessment Procedure (NPAP)-01, Rev 4, "Nuclear Performance Assessment Department Organization and Responsibilities," provides the organization and responsibilities of the Nuclear Performance Assessment Department. Nuclear Performance Assessment Procedure (NPAP)-02, Rev 2, "Independent Nuclear Safety Reviews," provides the process for performing and documenting independent nuclear safety reviews. These procedures were reviewed against ANSI N18.7, which provides guidelines for a written program for independent review and audits.

The licensee's procedures meet the intent of the standard.

d. Meeting Requirements

(1) Frequency

Palisades and Big Rock Point TS require that a committee to perform interdisciplinary reviews meet no less than twice per year. This is consistent with the ANSI N18.7 minimum meeting frequency. Palisades and Big Rock Point are currently meeting four times per year, alternating between sites.

(2) Quorum

Palisades and Big Rock Point TS require the interdisciplinary review committee to consist of the NPAD Director and four Nuclear Performance Specialists. Per ANSI N18.7, a quorum shall be no less than the majority of principals and the chairman should be present for all meetings. At the beginning of Independent Safety Review Meeting 93-02 held on May 24 and 25, four Nuclear Performance Specialists, the NPAD Director, and the Performance Trending and Analysis Supervisor were present. These six members of the ISR group met the requirements of the TS and constituted a quorum. Two of the other specialists attended portions of the meeting.

(3) Minutes

Meeting minutes for Independent Safety Review Meeting 93-01 held on February 12, 1993 were issued on February 18, 1993, although distribution was somewhat limited. The meeting minutes met the intent of ANSI N18.7 which states timely dissemination and identification of material reviewed.

In the executive summary of meeting minutes 93-01, an issue at Palisades regarding the planned test placement of the fuel transfer cask into the spent fuel pool was addressed. During review, the ISR group raised concerns regarding the tight clearances in the spent fuel pool during placement of the fuel transfer cask. The ISR group brought this issue to plant management's attention and resolution of the reviewer's concern resulted in movement of spent fuel to allow a larger area during placement of the fuel transfer cask. This was a significant safety concern identified by the ISR group which resulted in a change to the procedure which added conservative measures.

e. <u>Independent Safety Review Meeting 93-02 (May 24/25, 1993)</u>

During the meeting, the ISR group reviewed open items, discussed status of safety reviews, discussed plant events since the last meeting, discussed overview results, and discussed miscellaneous and emergent issues. In addition, the group held a one hour meeting with Big Rock Point management to improve communications on action items. During the interface meeting, the ISR group presented the requirements for independent nuclear safety reviews and the process for ISR. They emphasized that the process now involves the performance specialists contacting the individual who is responsible for addressing the action item request. This is to increase awareness. In addition, they reviewed the action items currently open for Big Rock Point. A similar meeting was held at

Palisades during the last Independent Safety Review Meeting. Meetings to review open action items will alternate from site to site with the ISR meeting.

Self Critique

The ISR group performed a self critique on 14 completed reviews. Two safety evaluations (one from each site) completed by each specialist were selected for review. Of those 14 reviews, 13 were acceptable as is and 1 was acceptable with comments. The self critique concluded that the reviews were performed satisfactorily.

f. Reports

(1) Annual Report

Palisades and Big Rock Point Technical Specifications require that senior Consumer Power Company management are provided with a report assessing the overall nuclear safety performance annually. The annual reports of nuclear safety performance at Palisades and Big Rock Point were reviewed for the past three years.

During the last three years, the period for review had shifted, the report format changed, and a report for each plant is now issued separately. While the reports from three years ago provided more detail, the existing format is acceptable and provides the relevant summary information. The current report format provides a written summary, a table of nuclear safety performance indicators, examples of independent safety review comments on safety evaluations, examples of independent safety review issues requiring action, a chart of independent safety review by category, a chart summarizing the independent safety review results, and an LER cause comparison. Most of the charts provide a comparison to the previous year.

During 1991, 808 reviews were performed. During 1992, 933 reviews were performed. In 1991, the ISR group made comments on 3.5 percent of the reviews, and requested action on 1.9 percent. In 1992, the ISR group made comments on 2.4 percent of the reviews, and requested action on .94 percent.

(2) Monthly Report

Palisades and Big Rock Point Technical Specifications require results of reviews to be reported to the Vice President-NOD, at least monthly. The monthly summary reports for 1993 were reviewed.

The report provides a quantitative summary of independent nuclear safety reviews and action items and a brief descriptive status for each open item.

The same summary of information was reviewed during the Independent Safety Review Meeting for reviews and action items as of May 21. The results showed 515 reviews have been completed year to date, 51 reviews are in progress, of which 46 are due in May/June, and 5 are overdue by 1-45 days. There appeared to be some uncertainty as to the status of the overdue items. Also, as of May 21, nine action items were open.

These reports and the review of status at meetings should provide adequate tracking of reviews and action items. Backlog problems identified during the past year seem to have been resolved, as indicated by the current status.

No violations, deviations, unresolved, or inspection followup items were identified in this area.

10. Management Meeting (30702)

a. A management meeting was held at the Region III office on June 28, 1993, with the personnel indicated in paragraph 11 in attendance.

The licensee opened the meeting with a description of the June 15, 1993, event at Palisades in which operators inadvertently failed to uncouple control rod number 39 and subsequently lifted that control rod during reactor head lifting operations. A summary of the licensee's subsequent recovery process, root cause analysis, and corrective actions were also presented.

The licensee outlined attributes of a 5-year management plan that was initiated at Palisades in 1987 which focused primarily on improving plant material condition. This plan was modified in 1991 based on management's recognition that more attention had to be focused on improving personnel performance and processes. A result of this modification was the adoption of a participative management style at Palisades which promotes worker accountability for performance. Discussions included descriptions of the measures taken to facilitate operator acceptance of this management style, the management training provided to supervisors, and the obstacles faced in implementing this new management style. The licensee acknowledged the need to improve communication within certain operating crews and between the operators and plant management.

The licensee presented performance indicator information which did not identify a declining trend in overall operator performance. However, the licensee reiterated that they view the June 15, 1993, event as being very serious and are performing a human performance

analysis to ensure that adequate corrective actions are taken to prevent recurrence.

The NRC communicated to the licensee that in light of barriers that broke down during the June 15, 1993, event, it should not be treated as an isolated incident or anomaly. Instead, the licensee should consider a broader evaluation to determine if a common thread exists that links this event with recent operational events involving personnel error. The regional administrator reiterated that it is the licensee's responsibility to ensure that the new participative management style provides an adequate level of checks and balances in the verification process. The importance of utilizing self-assessment measures, including third party audits, to identify performance weaknesses throughout the organization was also stressed. It was also noted that weaknesses identified in shift management and operations department communication should be aggressively assessed by the licensee to determine if these weaknesses are adversely impacting performance or are prevalent in other plant departments.

The licensee concluded by stating that similar personnel performance weaknesses have been identified in departments other than the operations department and that management would address these weaknesses in a broad manner. However, the licensee was not prepared to discuss their long-term plans for addressing these weaknesses. The licensee committed to meet with the NRC to discuss their long-term plans after they have been developed.

b. An enforcement conference, was held in the NRC Region III office on August 10, 1993. The purpose of the conference was to discuss a potential violation, with five examples, documented in Inspection Report 50-255/93016 (DRP) regarding the failure to uncouple a control rod prior to lifting the reactor vessel head.

11. Persons Contacted

Consumers Power Company

#M. G. Morris, Chief Operating Officer
#D. P. Hoffman, Vice President, Nuclear Operations
*#G. B. Slade, Plant General Manager
* R. D. Orosz, Nuclear Engineering & Construction Manager
* R. M. Rice, Director, NPAD
T. J. Palmisano, Plant Operations Manager
D. J. VandeWalle, Mech/Civil/Structural Engr. Manager
* D. W. Rogers, Safety & Licensing Director
K. M. Haas, Radiological Services Manager
* J. L. Hanson, Operations Superintendent
* R. B. Kasper, Maintenance Manager
* K. E. Osborne, System Engineering Manager
* C. R. Ritt, Administrative Manager
* D. J. Malone, Radiological Service Superintendent

* J. L. Kuemin, Licensing Administrator
  D. G. Malone, Operations Staff Support Supervisor
  W. L. Roberts, Senior Licensing Engineer
  R. W. Smedley, Staff Licensing Engineer

Nuclear Regulatory Commission (NRC)

 #J. B. Martin, Regional Administrator
 #H. J. Miller, Deputy Regional Administrator
 #E. G. Greenman, Director, Division of Reactor Projects
 #T. O. Martin, Acting Deputy Director, Division of Reactor Safety
  W. L. Forney, Deputy Director Division of Reactor Projects
 #W. D. Shafer, Chief, Reactor Projects Branch 2
 #B. L. Jorgensen, Chief, Reactor Projects Section 2A
*#B. C. McCabe, Acting Chief Reactor Projects Section 2A
* M. E. Parker, Senior Resident Inspector
* D. G. Passehl, Resident Inspector
  M. K. Gamberoni, Project Engineer, NRR
  T. Markley, Radiation Specialist
  T. Tella, Reactor Inspector

#Denotes those present at the management meeting on June 28, 1993.

*Denotes those present at the management interview on August 19, 1993.

Other members of the plant staff, and several members of the contract security force, were also contacted during the inspection period.

FUEL RESOLUTION PROJECT TEAM
July 22, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

Fuel shuffle completed to move SAN-08 and adjacent assemblies back into the core. I-027, I-028, I-052, M-48, M-49, and M-52 moved to the spent fuel pool for visual inspections. (See attached Inspection Summary)

Additional K bundles visually inspected in SFP as possible candidates for I replacements. One of eight assemblies exhibited localized spacer grid damage.

Daily conference call with Siemens Power focused on I replacement criteria, root cause to date, Generic Letter 90-02, and use of stainless steel rods in corner locations (details to be discussed at NRC conference call at 4:00 p.m. today).

2. UGS

Inserted fuel assembly SAN-8 into Z-11 core location. It was visually observed that the fuel assembly would seat on the core support plate in one orientation but not in a 180° rotated orientation without the presence of adjacent fuel assemblies.

UGS fuel alignment pin straightening was suspended after gaging and additional visual pin inspection identified concerns with pin profile (curvature) and pin material condition. At this time, we plan to replace alignment pins (2 at Z-11, 1 at Z-16) when the replacement process is approved.

3. Fuel Inventory

There was a conference call held with Dr. Helmholtz (NWT). We prepared a fuel accountability report which accounts for only 7% of the fuel from the failed rod.

4. Future Failure Detection Plan

Supplied NWT Corporation radiochemistry data. There was a conference call held with Dr. Helmholtz. His preliminary conclusion is that very few (approximately 3) fuel pellets are distributed in the PCS. Dr. Helmholtz was asked if he could have discerned a fuel failure based upon the chemistry data. He replied "no" and he stated that the exposed fuel appears to have been present from the beginning of the cycle. He is currently analyzing Cycle 9 data in order to determine if the exposed fuel may have been present in Cycle 9.

Activities Planned for the Next 48 Hours
July 22, 1993

1. Fuel Failure

Continued visual core support plate and shroud inspections of B-19 core location (I-24 fuel assembly core location). Continued inspections on core shroud. Procedure development for under core support plate inspection continues. Equipment procurement and setup will continue to support required inspections.

Complete visual inspections on I and M assemblies, evaluate root cause data to date and, possibly, make a decision on I assembly replacements by 1800 on 7/23. (Details to be discussed see attached I replacement criteria.)

2. UGS

CPCo personnel will go to Combustion Engineering to observe qualification testing and training for UGS fuel alignment plate pin replacement tooling.

Measurement and gaging activities to support UGS root cause evaluation will continue to be developed. Inclusive are UGS levelness, UGS fuel alignment plate straightness, and various reactor vessel/core measurement.

3. Fuel Inventory

Estimate the fuel deposit on I-024.

4. Future Failure Detection Plan

We will continue to transfer data to NWT for analysis.

INSPECTION SUMMARY TO DATE

~~August 4, 1993~~

July 22, 1993

I-024	Failed corners, missing and broken fuel rod
I-021	Corner indications
I-048	Corner indications
J-021	No significant indications
K-031	No significant indications
H-031	Corner indications
L-024	No indications
L-054	Two minor indications
L-059	Lead HTP two minor indications
L-060	Leat Htp, minor indications
SAN-08	UTP and visuals dimples on UTP, no other indications
SAN-08	Adjacent assemblies visuals, no indications
I-025	Visuals - to be performed 7/22
I-028	Visuals - to be performed 7/22
I-027	Visuals - to be performed 7/22
I-052	Visuals - to be performed 7/22
M-048 and 049	Visuals - to be performed 7/22
M-052	Visuals - to be performed 7/22
K's	Visuals as time permits, candidates for I replacement

I REPLACEMENT CRITERIA

- Burnup < 37,500 MWD/MTU
- No previous "corner" residence
- Spacer plate manufacturing orientation (logitudinal vs transverse rolling process)
- Flat exposure gradient
- Acceptable inspection results

At present time bundles J, K, and L under consideration.

FUEL RESOLUTION PROJECT TEAM
July 23, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

Visual inspections of I-027, I-028, I-052, M-52 were completed. The video tape is being reviewed, no conclusions yet.

Core support plate and shroud video inspections completed on B-19 and X-19 core locations. B-19 (where I-24 was located) shows visible fuel plume, guide bar and spacer rubbing. Evaluation of video for root cause effects continues. X-19 inspection completed overnight, evaluation of video ongoing.

In response to the requirements (Item 2) of the CAL, two representatives from Stoller Corporation arrived onsite to begin an independent assessment of the root cause analysis.

2. UGS

Continued observation of Combustion Engineering qualification testing and training for UGS fuel alignment plate pin replacement.

Root cause team eliminated two possible contributors:

1. Under sized fuel assembly upper tie plate pin holes in assembly SAN-8.

   This was based on satisfactory gaging of upper tie plate with a single hole gage and a four pin gage. No out of specification tolerance was observed by Siemans during fuel assembly fabrication.

2. Deformation of core shroud creating an interference between the UGS alignment pins and the fuel assembly. A camera inspection and video taping indicated no core shroud abnormalities which could create an interference.

3. Fuel Inventory

Sampled bundle I-28 in the elevator by smearing. Analysis is in progress.

Discussed issue with Bob Osborne of GE and Dr. Helmholtz of NWT. No conclusions derived yet.

4. Future Failure Detection Plan

Supplied radiochemistry data to NWT Corporation.

Activities Planned for the Next 48 Hours

1. Fuel Failure

   Complete visual inspection of M-48 and M-49 which were adjacent to I-24 during Cycle 9.

   Root cause team to evaluate all data available to date, determine if any additional inspections and/or analysis is necessary before recommending I assembly replacements. If data is considered sufficient, I replacement assemblies will be selected and work will commence toward final core configuration for Cycle 11 operation.

2. UGS

   Start UGS levelness measurements and flatness check of UGS fuel alignment plate.

3. Fuel Inventory

   Will sample by smear each bundle as they become available in the fuel elevator during the fuel shuffle necessary for inspection and I bundle replacement.

   Continue discussion with experts.

4. Future Failure Detection Plan

   There is a conference call planned this afternoon with Dr. Helmholtz of NWT Corporation.

Activities Planned for the Next 48 Hours

1. Fuel Failure

   The selection of the replacement L bundles will be finalized.

   The personnel involved in root cause evaluation and fuel inspections will be taking the weekend off.

2. UGS

   UGS levelness measurements and flatness check of the UGS flatness plate.

   Various reactor measurements will be taken to support a stack-up/tolerance study.

3. Fuel Inventory

   Efforts will continue in selecting and smearing particular fuel assemblies. Investigation will be made to determine if a standard smearing methodology exists.

   Discussion with our outside experts (Osborne and Helmholtz) will continue.

4. Future Failure Detection Plan

   We expect a written report from NWT Corp. next week and a detailed review of Palisades' fuel monitoring procedure the following week.

FUEL RESOLUTION PROJECT TEAM
July 25, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   Root cause team has taken the weekend off.

2. UGS

   Continued observation of ABB/Combustion Engineering qualification and training for UGS fuel alignment pin replacement. Reactor in-vessel measurements were obtained to support a tolerance/stack-up evaluation being performed for the UGS root cause plan. Preliminary review shows the measurements to be as expected.

3. Fuel Inventory

   Continue to analyze and review data from smears of fuel assemblies I-24 and I-28.

4. Future Failure Detection Plan

   No activity over the weekend.

FUEL RESOLUTION PROJECT TEAM
July 24, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

The Root Cause team completed reviews of I-025, I-028, I-027 and I-052 fuel bundles and the B-19 and X-19 core locations. The B-19 and X-19 core location inspections corrolated well with the rubbing seen on the I-024 and I-021 fuel bundles. The I-025, I-028, I-027 and I-052 fuel bundle inspections showed no noticable rubbing from interference with the shroud which confirmed modification to replacement bundles, by swapping 14 fuel rods with stainless steel pins to cover the bundle/shroud interfacing seen at B-19 and X-19 bundle/shroud core locations, will likely be bounding when applied to all 16 I-Hf replacement bundles. Visual inspections on all I-Hf bundles will be done to assure this modification bounds all 16 locations.
The selection of replacement bundles was narrowed down to the Batch L standard bundles. These L bundles will meet the original selection criteria of:

-Lower burnup (EOC 11 less than 37,000 MWD/MTU)
-Not previously on shroud corner
-No extensive bundle bow as determined by no large difference in exposure across the bundle.

Additionally, these L bundles avoid the need to UT the replacement bundles (which would have been likely if J's or K's were selected). The most important advantaqe of the L's over the J's and K's is the fact that the spacer side plates were produced so that radiation growth will not increase rod cell size as significantly as it would the J's and K's.

2. UGS

Continuing observation of Combustion Engineering Qualification testing and training for UGS fuel allignment pin replacement. CE procedure for pin replacement received for review.

3. Fuel Inventory

A presentation was made to the Plant Review Committee (PRC) regarding fuel inventory progress. Currently approximately 7% of the fuel from missing pellets can can be accounted for via liquid analysis and filter/ demineralizer activities. Efforts continue in order to quantify the amount of the missing fuel which is plated on the core surfaces.

4. Future Failure Detection Plan
Supplied more data to NWT Corporation.

Held a conference call and exchanged information with DR. Helmholtz. No conclusions were derived.

Activities Planned for the Next 48 Hours

1. Fuel Failure

   The selection of the replacement L fuel assemblies will be finalized.

2. UGS

   Obtain UGS levelness and fuel alignment plate (UGS bottom plate into which the fuel alignment pins are inserted) flatness measurements. Develop and obtain reviews for UGS fuel alignment plate pin replacement specification change. Review CE's procedure for UGS fuel alignment plate pin replacement.

3. Fuel Inventory

   Efforts will continue in selecting and smearing particular fuel assemblies on which fuel may have plated out. Investigation will be made to determine is a standard smearing technique exists that is more effective than the current method.

4. Future Failure Detection Plan

   A written report is expected this week from NWT Corp. Next week NWT will provide a detailed review of the Palisades fuel monitoring procedure.

FUEL RESOLUTION PROJECT TEAM
July 26, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   No activity

2. UGS

   UGS levelness measurements taken using a transit and datum pole. Data is being evaluated.

3. Fuel Inventory

   No activity

4. Future Failure Detection Plan

   No activity

Activities Planned for the Next 48 Hours

1. Fuel Failure

Activities will begin to prepare "L" candidate assemblies for I replacements, i.e., detailed visual examinations and stainless steel rod insertions from the H assemblies. A total of 14 stainless steel rods will be used at the corner locations of each assembly (8 in shroud corner location, 2 in each other corners). (See Attachment for L candidate data.)

2. UGS

Continue to prepare procedure and specification change for UGS fuel alignment plate pin replacement. Combustion Engineering to travel to Palisades 07/27/93.

Plan and schedule additional video/camera inspections for reactor vessel core support plate, core shroud, reactor vessel keys/guide pins.

3. Fuel Inventory

Continue to smear bundles in the fuel elevator.

Determine methodology to remove material (presumably failed fuel) plated on the shroud.

4. Future Failure Detection Plan

Receipt of a report from NWT Corporation is expected. The report will be reviewed to determine if it contains information which should affect the Palisades fuel monitoring procedure.

FUEL RESOLUTION PROJECT TEAM
July 27, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

Visual inspections were underway on the "L" bundle replacements. The plan is to visually inspect all 16 L bundles and then begin reconstitution with stainless steel rods.

2. UGS

Coordinated removal of assembly SAN-08 from location Z-11 for further inspection.

Incorporating core measurements and UGS measurements into UGS fuel alignment pin absolute positioning evaluation.

3. Fuel Inventory

Made an unsuccessful attempt to obtain a sample of the material causing discoloration at the 0° and 270° keyways on the UGS lower plate.

4. Future Failure Detection Plan

No significant activity - waiting for NWT report.

Activities Planned for the Next 48 Hours

1. Fuel Failure

   Complete visual inspections on "L" assemblies and begin reconstitution. Prepare for PRC approval to reconfigure the core to the final cycle 11 reload pattern.

2. UGS

   Perform several more vertical measurements in the reactor core and video tape inspect the reactor vessel alignment pins.

   Perform UT measurements in the UGS lift rig leveling studs to verify equal load distribution. Also take more UGS levelness measurements.

3. Fuel Inventory

   Review calculations of the amount of fuel already recovered. An incorrect factor was used in the original calculations. Fuel recovery will be greater than the previously estimated 7%.

   Vacuum the core shroud at the B-19 location where there is discoloration which may be fuel from the failed rod.

   Make new video's of the UGS lower plate. Again check the 0° and 270° locations.

4. Future Failure Detection Plan

   Expect receipt of the NWT report.

FUEL RESOLUTION PROJECT

July 28, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   - Visual inspections were completed on all "L" assemblies. All assemblies are acceptable in this regard; however, bundle bow calculations received late last night from Siemens Power Corp. put into question the acceptability of some or all of the candidate bundles. The bow may be unacceptable with regard to minimizing any interference with the shroud during operation. Re-constitution of these assemblies with stainless steel corner rods has not begun and is on hold pending the evaluation of this concern. The PRC meeting scheduled for today on the reload has been postponed.

2. UGS

   - Additional measurements using transit and datum pole were taken for core support plate Z-11 location and core support barrel flange.

   - Transit measurements were evaluated for UGS fuel alignment plate flatness. The plate was determined not to have any distortion in the 270° area (Z-11 location). These measurements, along with video inspection of UGS, have eliminated deformation of the UGS as a possible contributor for the stuck fuel assembly.

   - Additional visual inspection of the core shroud, core support barrel flange, and reactor vessel pins were completed. The results are being evaluated.

3. Fuel Inventory

   - Surveys in the spent fuel pool demineralizer area found elevated dose rate. This is being investigated.

4. Future Failure Detection Plan

   - No significant activity - still waiting for the NWT report.

FUEL RESOLUTION PROJECT

July 28, 1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   - Evaluate the bundle bow concern, re-evaluate all acceptance criteria for any I replacements and finalize the replacement assemblies. We will then reschedule the plant PRC meeting and determine the schedule for proceeding with assembly reconstitution. A Thursday (7/29) conference call with the NRC on the fuel failure and reload plan currently being arranged will most likely have to be rescheduled to Friday or later (discuss further at 4:00 pm today).

2. UGS

   - In-processing of Combustion Engineering personnel and pin replacement tooling arrival at Palisades.
   - System Engineering and PRC review of the pin replacement procedure and specification change.
   - Take additional measurements of UGS alignment plate if required after evaluating current measurements.
   - Determine if UGS lift rig stud elongation UT measurements are feasible.

3. Fuel Inventory

   - Evaluate data from spent fuel pool demineralizer area.
   - Perform camera inspection below reactor core support plate.

4. Future Failure Detection Plan

   - Expect to receive and review the NWT report today (07/28/93).
   - Attempt to obtain copies of fuel monitoring procedures from other plants that have experienced fuel loss.

FUEL RESOLUTION PROJECT
July 29, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   - We have evaluated our concern with bundle bow in the L bundles, reviewed all of our acceptance criteria with Siemens Power, and have come to agreement on a course of action. As a result, over the next 24 to 48 hours a different set of "L" bundles (with less exposure gradient) will be evaluated for use. Additionally, we determined that the replacement assemblies will be oriented with any bow facing the interior of the core (interference with control rod movement has been determined to not be an issue with the new candidates).

2. UGS

   - Additional upper guide structure levelness measurements were obtained to assist in determining repeatability of levelness with each lift. Variations of 1/8" to 3/8" levelness were observed.

3. Fuel Inventory

   - Reviewed data from the dosimeter at the spent fuel pool demineralizer area.
   - Completed the camera inspection under the core support plate and taped the results.

4. Future Failure Detection Plan

   - Received NWT Corporation report.

FUEL RESOLUTION PROJECT
July 29, 1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   - Evaluate new I replacement candidates and develop a revised loading pattern (physics, safety analysis, fluence effects considered). Plant PRC is tentatively scheduled for Monday (8/2) to review the final loading plan. The NRC conference call on fuel failure and final reload plan should be scheduled after this.

2. UGS

   - Begin the UGS fuel alignment plate pin replacement.

3. Fuel Inventory

   - Vacuum shroud to quantify the amount of fuel on the shroud.
   - Detailed review of the video tape of the inspection below the core support plate.
   - Continue evaluating data from the spent fuel pool demineralizer area.

4. Future Failure Detection Plan

   - Complete review of the NWT report.
   - Begin drafting a fuel failure detection plan.

REVISED

FUEL RESOLUTION PROJECT
July 30, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   - All 16 revised I assembly replacements (L bundles) were visually inspected. Physics, fluence and safety analysis effects were evaluated in the development of a revised core loading pattern. NRC questions and general areas to be addressed at a future conference call were received. Discussion took place between CPCo and the NRC and between CPCo and Siemens Power concerning 50.59 of the revised reload plan. We understand the NRC's position and concerns and will be prepared to address these issues as we move through the reload and ultimately before we start up.

2. UGS

   - Began preparations for upper guide structure fuel alignment plate pin replacement.

3. Fuel Inventory

   - Continued to evaluate data from the dosimeter at the spent fuel pool demineralizer area.
   - Continued to smear fuel assemblies.
   - Rescheduled the vacuuming of the core shroud in the B-19 area until early next week.

4. Future Failure Detection Plan

   - Reviewed NWT report.

FUEL RESOLUTION PROJECT
July 30, 1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   - Review the video tapes of the L bundle inspections and complete the reload plan. If all looks good, reconstitution of the L bundles with stainless steel corner rods will commence and continue throughout the weekend.

2. UGS

   - Replace the UGS fuel alignment plate pin at core location Z-11 (North).

3. Fuel Inventory

   - Continue evaluating data.

4. Future Failure Detection Plan

   - A representative from the Big Rock Point Chemistry Department will be on-site to discuss the fissions/second analysis and how it can be applied at Palisades.

FUEL RESOLUTION PROJECT
July 31, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

One L fuel bundle has been reconstituted with stainless steel rods.

2. UGS

Continued with set-up of EDM tooling to cut off UGS alignment pin Z-11 (North) nut and upper pin length. Some tooling interferences were encountered and are being resolved.

3. Fuel Inventory

Surveyed the 602' elevation pipeway and the upper West Engineered Safeguards Room. No hot spots were identified.

4. Future Failure Detection Plan

Reviewed the Source Term Analysis method of detecting fuel failure with Big Rock Point personnel who have used it before.

July 31,1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   Continue review of the video tapes of the L bundle inspections.

   Continue reconstituting L fuel bundles.

   Continue working on the root cause determination.

2. UGS

   Continue to replace UGS alignment pin Z-11N.

3. Fuel Inventory

   Vacuum the shroud area in the B-19 location.

   Obtain a sample from the bottom of the reactor vessel.

4. Future Failure Detection Plan

   Continue to evaluate and test the Source Term Analysis method of detecting fuel failure.

FUEL RESOLUTION PROJECT
August 1, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   Additional L bundle reconstituted with Stainless steel rods.

2. UGS

   Resolved UGS Fuel Alignment Plate pin replacement tooling interferences. The Z-11N (North) pin nut and upper shank were removed with Electro-Discharge Machining (EDM).

3. Fuel Inventory

   Two additional area surveys completed; no unusual results uncovered.

4. Future Failure Detection Plan

   No information available this morning.

FUEL RESOLUTION PROJECT
August 1, 1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   Continuing with reconstitution of L bundles.

2. UGS

   Continue with UGS Fuel Alignment plate pin Z-11N replacement and gaging.

3. Fuel Inventory

   Vacuum shroud, B-19 location in particular.
   Sample debris below core support structure in Reactor Vessel lower head region.
   Continuing with surveys.

4. Future Failure Detection Plan

   No information available this morning.

FUEL RESOLUTION PROJECT
August 2, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

Reconstitution of L assemblies is underway. Four of the 16 assemblies were complete as of 0800 today. A revised assembly list and selection criteria is attached.

An inspection of the reactor cavity side tilt pit was performed and a piece of cladding may have been found.

2. UGS

UGS fuel alignment pin Z-11(North) was removed.

3. Fuel Inventory

A sample of the foreign material seen on the reactor bottom was retrieved. Preliminary observation indicates it is similar to the substance obtained by smearing fuel assemblies.

The vacuuming of the core shroud was again postponed because of the lack of crane availability due to the UGS pin replacement process.

Future Failure Detection Plan

Continued testing of the Source Term Analysis method of fuel failure detection.

August 2,1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

Reconstitution efforts will continue.

The PRC is scheduled to meet at 1300 hrs today to review the revised reload plan. A telephone conference is planned for 1400 hrs tomorrow to discuss this same subject and to answer specific NRC questions.

Additional tilt pit inspection to positively identify the foreign material seen in the reactor cavity tilt pit (thought to be a piece of cladding) and develop a recovery plan if it is the missing cladding.

Clarification regarding the 50.59 evaluation of the reload during today's 1600 hrs telephone conference.

2. UGS

Continue with replacement of Z-11 (North) pin and functionality gaging of that pin once it is replaced.

3. Fuel Inventory

Vacuum the shroud to obtain sample material form the area adjacent to the B-19 location (timing depends on crane availability).

Continue to smear assemblies as they become available in the SFP elevator.

4. Future Failure Detection Plan

Continue testing of the Source Term Analysis method.

Review Connecticut Yankee's fuel failure detection procedure and INPO Good Practice T3-409 for applicability to Palisades.

ASSEMBLY EXPOSURE(MWD/MTU)

L-02	36,570	L-14	30,446
L-05	36,570	L-16	30,446
L-08	36,570	L-18	30,446
L-11	36,570	L-20	30,446
L-13	30,705	L-33	37,709
L-15	30,705	L-51	37,709
L-17	30,705	L-55	37,709
L-19	30,705	L-56	37,709

ACCEPTANCE CRITERIA:

1. BURNUPS < 37,500 MWD/MTU AT EOC FOR J AND K ASSEMBLIES ONLY

   Somewhat arbitrary and less important if L Bundles used, however attempt was to stay < I-024 BOC Burnup when I-024 was not yet failed. Design Limit of 46,000 MWD/MTU for L assemblies still applicable due to different design on spacer grid.

2. Not Previously on of the eight octant symmetric corner shroud position that I-024 was in when failed.

   Conservative perhaps to apply all 8 locations. Definitely want to avoid previous X-19, B-19 residence bundles in case some damage already invoked on bundles.

3. Bundle Bow not excessive in relation to I-024 flux gradient

   Bundle/shroud interference is already at B-19 and X-19 locations. Bundle bow towards shroud may add to problem. Bundle bow away from shroud at BOC must consider potential impact on adjacent control rod.

4. L assemblies may have some advantage over J & K assemblies.

   Spacer Plate Material was stamped in preferential directional to minimize cell opening due to growth. Also using L will not require UT where as J and K assemblies will require UT.

5. Fluence rate values should not exceed Cycle 9 values.

   Cycle 9 fluence rates were used for the current PTS submittal being reviewed by the NRC.

Palisades Fuel Failure and Reload Plan

Conference Call 8/3/93

Agenda

I. Fuel Inspection Summary

II. Root Cause Analysis Summary

III. "I" Replacement Assembly Selection Criteria

IV. Revised Cycle 11 Core Configuration

V. Reload "O" and Cycle 11 Licensing Considerations

VI. Failed Fuel Rod Accountability and Impact on Fuel Integrity During Cycle 11 Operation

I-024 FAILED ROD EVENT INSPECTION RESULTS SUMMARY

1. 7-1-93 0930 INSPECTION OF UNKNOWN ITEM

Unknown item inspected in south tilt pit using camera and known OD plug to determine its OD.

RESULTS: Item appears to be a piece of fuel rod, about 5 feet long.

2. 7-1-93 2100 TILT PIT AREA INSPECTION

Accessible areas of the reactor cavity tilt pit were inspected using a camera to determine if other pieces existed.

RESULTS: 4 pieces found totaling about 11 feet; one had a lower end cap. Total length of one of the pieces could not be positively estimated, since it was not entirely visible.

3. 7-2-93 A-SHIFT INSPECTION OF LOWER END CAP

Camera inspection of lower end cap was performed in an attempt to identify its serial number.

RESULTS: Serial number was read and later that morning was identified to belong to assembly I-024 corner rod S-15.

4. 7-4-93 A-SHIFT DETAILED EXAM OF ROD PIECES BY SIEMENS

Rod pieces were moved to the south end of the tilt pit and a detailed examination was performed. Only 3 pieces were located at this time. Total length is still approximately 11 feet. Fourth piece that CPCo saw earlier was not found. At this time it was postulated that CPCo had mistaken a hose and shadows for a rod piece.

RESULTS: The three pieces were characterized in detail. Big picture results are:

a. One piece has a severe longitudinal split with an estimated 5 feet of fuel missing.
b. Severe wear exists at spacer locations.
c. Upper end cap not located.
d. One 18 inch piece appears to contain fuel.
e. No obvious fuel pellets seen on the floor.

5. **7-4-93 C-SHIFT TO 7-5-93 A-SHIFT FRAGMENTED ROD RECOVERY**

Siemens retrieved the rod pieces and placed them in storage baskets. Visuals were made of the process.

RESULTS: One end of the 4 1/2 foot piece verified visually to contain fuel. The larger 5 foot piece appeared to be more than just split. Likely cladding material is missing from this piece. The 4 1/2 foot piece fit well to the 18 inch piece.

6. **7-5-93 A-SHIFT REFUELING MACHINE HOIST BOX INSPECTION**

A camera inspection of the refueling machine hoist box was performed to check interior for damage or protrusions.

RESULTS: Completed with no damage found.

7. **7-6-93 B-SHIFT TILT MACHINE CARRIER INSPECTION**

A camera inspection of the tilt machine carrier was performed to check interior for damage or protrusions.

RESULTS: Completed with no damage found.

8. **7-6-93 1800 REVIEW OF EARLIER I-021 VISUAL EXAM**

The video tape of I-021 visual exam performed earlier in the refueling outage was reviewed in light of the problem with I-024.

RESULTS: The corner rod of I-021 that was located next to the core shroud was observed to be loose at spacer number 7. The is the equivalent position to I-024 failed rod.

9. **7-8-93 REVIEW OF I-021 AND I-024 VISUALS TAKEN DURING CYCLE 8**

The video tape of I-021 and I-024 that was taken during cycle 8 to support the I-Hafnium installation project was reviewed.

RESULTS: No observed problems seen.

10. **7-12-93 REVIEW OF LAST REFUELING I-021 AND I-028 VISUALS**

The video tape of last refueling outage visual of I-021 and its sister assembly I-028 was received from Siemens and reviewed.

RESULTS: No observed problems seen.

11. **7-12-93 I-024 IN CORE INSPECTION**

View of I-024 from the top as it sat in the core after the UGS removal was taped.

RESULTS: No observed damage or markings to note on the upper tie plate. A piece of spacer side plate of about 1/4 inch width was located on the shroud. (This piece was later vacuumed up.)

12. **7-13-93 I-024 IN CORE INSPECTION PRIOR TO REMOVAL**

View of I-024 as it sat in the core prior to removal and the piece that fell from the bundle as it was move to the tilt machine was taped.

RESULTS: The observed damaged was documented in detail. Big picture results are:

a. Severe spacer damage exists.
b. The dropped piece was the upper end of the failed rod and accounts for the remainder of the failed rod's length.
c. The assembly was judged to be acceptable for transport to the spent fuel pool using the normal refueling equipment.

13. **7-13-93 DETAILED VISUAL OF I-024 IN THE SPENT FUEL POOL**

A detailed visual of all four sides of I-024 was performed.

RESULTS: The observed damage was documented in detail. Big picture results are:

a. Spacers 1-5 appear freshly torn.
b. Spacers 6-9 have corner material missing. These spacers show a failure mechanism apparently different than the first five spacers, (as determined by oxide, rub marks, and failure locations).
c. Adjacent rods to the failed position show fretting within span 9, suggesting the failed rod was severed partially or completely in this span during operation.
d. A fuel plume was observed starting near the top of span 9.

14. **7-13-93 VISUAL AND RETRIEVAL OF THE ROD PIECE ON THE CORE**

The rod piece that fell from I-024 during its transit to the tilt machine was retrieved while being taped. It was placed in the storage basket along with the remaining fragmented rod pieces.

RESULTS: This piece was about 6 inches long and seemingly would have fit well with one end of the 5 foot long piece.

15. **7-14-93 VISUAL OF I-021**

A visual exam of I-021 was performed with particular emphasis to have corner rods well focused.

RESULTS: Loose rods observed as well as rod S-1 had large wear marks at spans 5 and 6 on both sides A and B which would have been in the core shroud corner during cycle 10 operation.

16. **7-15-93 I-024 INDIVIDUAL ROD EXAMS**

Individual rods from I-024 were examined for withdrawal force, eddy current testing, and visual examinations. The 3 rods adjacent to failed rod S-15 were not examined due to spacer cell damage.

RESULTS: Corner rods on sides adjacent to the shroud during Cycle 10 had several indications of up to 12 mil depth from fretting at the spacer cell locations.

17. **7-16-93 I-021 INDIVIDUAL ROD EXAMS**

Individual rods from I-021 were examined for withdrawal force, eddy current testing, and visual examinations.

RESULTS: Corner rods on sides adjacent to the shroud during Cycle 10 had several indications of up to 12 mil depth from fretting at the spacer cell locations. The visual on rod S-1 confirmed rubbing wear at spans 5 and 6 from the shroud corner during Cycle 10 operation.

Note: At this time, the decision was made not to re-use the I-Hafnium assemblies in Cycle 11. Inspections for root cause continued with emphasis on ability to justify use of replacement bundles.

18. **7-17-93 I-048 EXAMINATION**

An assembly visual of I-048 was performed as well as examinations of selected individual rods for withdrawal force, eddy current testing, and visual examinations. This bundle was in core location B-19 during the previous Cycle 9. Also, rod selection pattern for individual rod examinations was modified to better check status of interior rods.

RESULTS: Assembly visual overall looked good. Corner rods on sides adjacent to the shroud during Cycle 9 or 10 had several indications of up to 6 mil depth from fretting at the spacer cell locations. Interior rods all looked good.

19. **7-18-93 J-021 AND K-031 EXAMINATIONS**

Potential replacement candidates J-021 and K-031 were examined. Assembly visuals were performed as well as examination of individual rods.

RESULTS: Assembly visuals overall looked good. Corner rods and interior rods looked good. Only one minor indication seen on each assembly.

20. **7-18-93 H-031 EXAMINATION**

An assembly visual of H-031 and an examination of selected individual rods was performed. This bundle had resided in core location B-19 during Cycle 8. Cycle 8 was its fourth cycle of burn. EOC 8 burnup was 37,625 MWD/MTU. Also, H-031 never saw the increased PCS flow that resulted from the S/G replacement that occurred at EOC 8.

RESULTS: Assembly visual indicated one side may have been rubbing against the core shroud during Cycle 8. Corner rods on a side adjacent to the shroud during Cycle 8 had several indications of up to 8 mil depth from fretting at the spacer cell locations. Additional, a corner rod that was not on the core shroud had several indications of up to 8 mil depth from fretting at the spacer cell locations.

21. **7-19-93 L-024 EXAMINATION**

An assembly visual of L-024 and an examination of selected individual rods was performed. This bundle resided on the core shroud between bundles I-048 and I-024 during Cycle 10.

RESULTS: Assembly visual and individual rod exam results were good.

22. **7-19-93 L-054 EXAMINATION**

An assembly visual of L-054 and an examination of selected individual rods was performed. This bundle had the highest 3 cycle core residence burnup of all standard bundles, 37,709 MWD/MTU. Also, L-054 had never resided on a core shroud location.

RESULTS: Assembly visual and individual rod exam results were good. Two minor indications were seen on one rod.

23. **7-20 & 21-93 L-059 AND L-060 EXAMINATIONS**

Lead High Thermal Performance (HTP) spacer design assemblies L-059 and L-060 were examined to check performance of spacer design that affects the majority of Cycle 11 core design. Assembly visuals and individual rod examinations were performed.

RESULTS: Assembly visuals and individual rod exam results were good. Some minor indications were seen on a few rods.

24. **7-21-93 I-025, I-027, I-028, AND I-052 EXAMINATIONS**

Assembly visuals on these 4 I-Hafnium assemblies were performed to check for any indications of rubbing or damage.

RESULTS: Loose corner rod(s) was(were) seen in assemblies I-025 and I-027.

25. **7-26-93 M-048 AND M-049 EXAMINATIONS**

Assembly visuals on M-048 and M-049 were performed to check for any indications of damage. These two assemblies plus the previously examined I-025 were adjacent to I-024 during Cycle 9. The Cycle 9 core loading indicated some difficulty about this area.

RESULTS: Assembly visuals showed no handling damage.

26. **7-22-93 CORE LOCATION B-19 VISUAL**

Core location B-19 where I-024 resided during Cycle 10 was visually examined.

RESULTS: Rub marks from assembly I-024 evident. Guide bar rub marks heavier on west side and spacer rub marks heavier on south side. Rub marks from S-15 corner rod evident from assembly spans 5 through 9.

27. **7-23-93 CORE LOCATION X-19 VISUAL**

Core location X-19 where I-021 resided during Cycle 10 was visually examined.

RESULTS: Rub marks from assembly I-021 evident. Rub marks from S-1 corner rod evident from assembly spans 5 and 6.

28. **7-27-93 I-056, J-056, AND K-056 EXAMINATIONS**

These assemblies resided in core location B-19 during Cycles 5, 6, and 7, respectively. Minor wear due to interfacing with the shroud likely would not be seen due to two subsequent cycle burns for each of the assemblies. However, significant wear or damage seen may help determine whether shroud/assembly interfacing issue is an old problem.

RESULTS: No conclusive evidence of shroud rubbing seen. I-056 did have a damaged spacer grid, however, the damage appeared unrelated to the I-024 failed rod issue.

29. **7-28-93 SAN-08, I-021, AND L-052 LENGTH MEASUREMENTS**

Length measurements of these bundles were made to verify growth within design expectations.

RESULTS: Length measurements were within design expectations and, more importantly, were not indicating growth necessary to interfere with UGS bottom plate.

30. **7-29-93 CORE LOCATION B-5 VISUAL**

Core location B-5 was where I-025 resided during Cycle 10. This core location visual was to see what a potentially "good" corner shroud location looked like, since I-025 visual did not indicate any interference rubbing.

RESULTS: Rub marks evident from I-025 guide bar span 9 on the north side. Spacer 9 may have also been rubbing.

31. **7-30-93 REPLACEMENT ASSEMBLY VISUALS**

Assembly visuals were performed on 16 assemblies selected as candidate replacements for the I-hafnium assemblies.

RESULTS: All found to be acceptable.

Root Cause Status Summary
I-024 Failed Rod Event

8-2-93

A. Potential Root Causes That Have Been Eliminated

1. Damaged during fuel moves during previous cycle - tilt machine problem, refueling machine problem, operator error, or handling event.

   Reasons Eliminated:

   a. No documentation found to support this cause.
   b. Snag hazards or damage on the tilt machine carrier and refueling machine hoist box not found.
   c. I-024 was rubbing against the core shroud during Cycle 10 operation.

   Conclusion:

   This causal factor was not the root cause. The possibility exists that this causal factor contributed to the event perhaps adding to the damage that I-024 received.

2. Damaged during EOC 9 UT inspection.

   Reasons Eliminated:

   a. No documentation found to support this cause.
   b. S-15 rod was not in the corner held by the UT clamp.
   c. Damage to UT rig likely occurred due to lifting the base plate, not due to a fuel bundle, per (SPC) Siemens Power Corp.
   d. UT rig potentially affects the bottom of a fuel assembly, just above spacer number 1. I-024 damage occurred between spacers 5 and 10.
   e. I-024 was rubbing against the core shroud during Cycle 10 operation.

   Conclusion:

   This causal factor was not the root cause and likely was not a contributing factor.

3. Damaged during fuel moves this refueling - tilt machine problem, reactor machine problem, core structural interference problem, or operator error.

   Reasons Eliminated:

   a. Inspection of tilt machine and refueling machine hoist box showed no damage or snag hazards.
   b. No documentation to support these casual factors.
   c. Rod S-15 was failed during Cycle 10.
   d. I-024 was rubbing against the core shroud during Cycle 10 operation.

Conclusion:

These causal factors were not the root cause and likely were not contributing factors.

4. Fuel failure due to loose spacer grid.

Reasons Eliminated:

a. B-19 and X-19 core locations showed that an interference with spacers is occurring.
b. B-19 core location showed guide bars above spacer 10 were in contact with the shroud.

Conclusion:

This causal factor was not the root cause. However, it may have been a contributing factor. Spacer grid design must be addressed sufficiently to justify no concern exists for the replacement bundles.

B. Potential Root Causes That Are Considered Unlikely

1. Fuel failure due to increased PCS flow.

Reasons Considered Unlikely:

a. H-031 inspections showed evidence of interference with shroud at its Cycle 8 B-19 core location. S/G replacement and increased flow occurred after Cycle 8.
b. Inspections of other non-I Hafnium bundles that have resided in the core during Cycle 9 and 10 showed no problems.
c. Core location B-19 inspection showed I-024 guide bars above spacer 10 were in contact with the shroud.
d. Flow at peripheral core locations is 6% lower than flow in the center, but only problems at the peripheral locations seen.

Conclusion:

This causal factor is considered unlikely to be a root cause. However, it may be a contributing factor. Reactor noise analysis may help indicate likelihood of being contributing factor.

2. Fuel failure due to core barrel vibration.

Reasons Considered Unlikely:

a. L-024 inspection results showed no problem.
b. Core location B-19 inspection showed I-024 guide bars above spacer 10 were in contact with the shroud.

Conclusion:

This causal factor is considered unlikely to be a root cause. However, it may be a contributing factor. Reactor noise analysis may help indicate likelihood of being contributing factor.

3. Fuel failure due to manufacturing failure.

Reasons Considered Unlikely:

a. I-024 has severely damaged spacer grids at the corner.
b. Manufacturing failure normally would show up earlier in operating history.
c. B-19 and X-19 core locations showed that an interference with spacers is occurring.
d. B-19 core location showed guide bars above spacer 10 were in contact with the shroud.
e. Manufacturing records reflected no associated problems.

Conclusion:

This causal factor was not the root cause and likely was not a contributing factor.

C. Potential Root Causes That Are Considered Likely

1. Fuel failure due to shroud problem.

Reasons Considered Likely:

a. Core locations X-19 and B-19 showed that an interference with spacers is occurring.
b. B-19 core location showed guide bars above spacer 10 were in contact with the shroud.
c. I-024 has severely damaged spacer grids at corners, with spacers 6 through 9 likely failed due to fretting.
d. I-021 showed evidence of interference with shroud at core location X-19.

Conclusion:

This shroud/bundle interface problem really is considered the likely proximate cause. True root cause(s) must still be determined considering potential contributing factors.

Root cause might be: 1. shroud distortion from operating conditions/cycling, 2. shroud distortion due to loose or broken bolting, 3. misalignment between UGS and core support barrel, or 4. problem always existed from original as-built conditions, however, addition of some contributing factors was required to obtain the conditions to cause the I-024 failed rod event.

Contributing factors might be: 1. I-024 was burned 5 times, 2. minor damage on I-024 may have existed from a handling event, 3. I-024 loose spacer grids, 4. increased PCS flow due to S/G replacement after Cycle 9, 5. core barrel vibration changes, 6. localized PCS flow changes due to introduction of (HTP) High Thermal Performance fuel bundles, 7. fuel bundle bow, or 8. fuel bundle twist.

Recommended Actions With Respect To Root Cause Determination:

A. For potential root causes 1 and 2, visual inspections already confirmed no gross distortion exists and bundle inspections imply condition may have existed at least since Cycle 8. Following further actions are recommended:

   1. Perform assembly visuals on remaining 10 I-Hafnium assemblies when they are removed from the core to assure remedial corrective action modifications being made to replacement bundles remains bounding.

   2. Performed already planned inspections of any core locations associated with I-Hafnium assemblies that show signs of assembly/shroud interfacing.

   3. In future refueling when core offload performed, performed more detailed inspection of the core shroud.

B. For potential root cause 3, no further action beyond that ongoing by the UGS/Stuck Bundle root cause team.

C. For potential root cause 4, contributing factors need to be addressed to help assure failure of a rod does not occur during any future cycle. Following further actions are recommended:

   1. Don't burn a standard design bundle more that 5 cycles unless and until this factor can be eliminated as a possible contributor.

   2. Address spacer relaxation seen on the standard design bundles sufficiently to justify no concern exists for the replacement bundles.

   3. Evaluate replacement bundles for bundle bow with the criteria that interference with the core shroud is avoided or minimized.

   4. Perform a qualitative evaluation of B-19 core location localized flow conditions with respect to the additional HTP bundles in Cycle 11 to attempt to address impact, if any.

   5. Review parts reactor noise analysis of Cycles 8,9, and 10 for changes or trends.

Inspection Plans For I-024 Failed Rod Event

Visually Inspect Core Locations B-19 & X-19

Reason: Locations where I-024 & I-021 resided, respectively. Looking for gross shroud distortion, rub marks from bundles, core plate obstructions & check for proper seating.

Review Period for Data Collected To Date

Reason: To determine if sufficient data has been obtained with respect to the root cause evaluation to enable decision on appropriate remedial corrective action required to cover operation of Batch J,K or L Bundles for one cycle as replacements to the I-Hf.

Bundle Selection Process

Objective: Selection criteria that was to be considered is attached, 4 items. Additionally, if J,K & L were evently matched, L would be preferred to avoid need to UT replacement bundles that might have been desired on J&K.
Reason: J&K operated one & two cycles respectively after being UT'd or sipped. L's were in for Cycle 10 which showed no typical defects from average powered fuel rods.

See pg 2, Selected Bundle Visuals

From Page 1

≈

Selected Replacement Bundle Visuals

Reason: To verify no assembly damage that would disqualify reuse (example: spacer damage) and perhaps affect use of its symmetric assemblies.

Swap 14 Rods in each Replacement Bundle Per Attached Plan with S.S.

Reason: Corner of assembly with 8 S.S. replacement rods would be placed towards shroud corner. Fuel rod fretting is avoided. If spacers fretted through like I-024, corner rod would likely remain in place, captured by spacers 1-5 and 10. For other 3 assembly corners, one S.S. rod of 0.437" OD could replace one fuel rod, tightening up entire 4 cell corner area which shares a common lantern spring. Two S.S. rods per corner was selected to place evently distributed load on affected rods.

In parallel with the above activities, Pages 3&4 provides inspection items which pertain to root cause investigation of either I-024 failed rod event and/or UGS/SAN-08 stuck bundle event. Root cause inspection items are prioritized above the remedial action of replacement bundles when possible.

SAN-08 Length Measurement	Reason:	To verify growth was as predicted per design calcs.
Replace SAN-08 Upper Tie Plate	Reason:	Use of a modified upper tie plate is seriously being considered as an insurance step to possibly help avoid future sticking to UGS.
I-021 Length Measurement	Reason:	To verify assembly growth was as predicted per design calcs. Should be representative of I-024 too. Prefer to handle I-021 verse damaged I-024 for this item.
L 052 Length, Assembly Visual including better look at lower tie plate pins	Reason:	Bundle required high extraction force to remove at beginning of present refueling outage. Lean during removal process raises question as to how much of one of its lower tie plate pins was inserted into core support plate. If up 0.69", then possible linking to I-024 event may exist if UGS positioning affected.
Visually Inspect Core Locations B-5 & X-5	Reason:	These are locations where I-025 & I-028 resided during Cycle 10. No noticeable rubbing was seen on these bundles. Desire here is to see what potentially "good" corner shroud location look like.

Assembly Visuals on Remaining 10 I-Hf Assemblies When They Are Removed From The Core

Reason: Further root cause data input to see if other locations affected. Also, needed to assure any remedial modification corrective action taken to replacement bundles (S.S. rod placement pattern) remains bounding

Visually Inspect Any Core Locations Associated With I-Hf Assemblies That Shows Signs of Assembly/ Shroud Interfacing

Reason: To better characterize interfacing and to perhaps assist in root cause determination.

Assembly Visuals on I-56, J-56 and K-56

Reason: Assemblies were located at core location B-19 during Cycles 5,6 & 7, respectively, as new bundles. Minor wear due to interfacing with shroud likely not possible to see due to each burned in core 2 subsequent cycles. However, significant wear or damage may help determine whether the shroud/ bundle interfacing issue is an old problem.

FUEL RESOLUTION PROJECT

July 28, 1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   - Evaluate the bundle bow concern, re-evaluate all acceptance criteria for any I replacements and finalize the replacement assemblies. We will then reschedule the plant PRC meeting and determine the schedule for proceeding with assembly reconstitution. A Thursday (7/29) conference call with the NRC on the fuel failure and reload plan currently being arranged will most likely have to be rescheduled to Friday or later (discuss further at 4:00 pm today).

2. UGS

   - In-processing of Combustion Engineering personnel and pin replacement tooling arrival at Palisades.
   - System Engineering and PRC review of the pin replacement procedure and specification change.
   - Take additional measurements of UGS alignment plate if required after evaluating current measurements.
   - Determine if UGS lift rig stud elongation UT measurements are feasible.

3. Fuel Inventory

   - Evaluate data from spent fuel pool demineralizer area.
   - Perform camera inspection below reactor core support plate.

4. Future Failure Detection Plan

   - Expect to receive and review the NWT report today (07/28/93).
   - Attempt to obtain copies of fuel monitoring procedures from other plants that have experienced fuel loss.

FUEL RESOLUTION PROJECT
July 29, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   - We have evaluated our concern with bundle bow in the L bundles, reviewed all of our acceptance criteria with Siemens Power, and have come to agreement on a course of action. As a result, over the next 24 to 48 hours a different set of "L" bundles (with less exposure gradient) will be evaluated for use. Additionally, we determined that the replacement assemblies will be oriented with any bow facing the interior of the core (interference with control rod movement has been determined to not be an issue with the new candidates).

2. UGS

   - Additional upper guide structure levelness measurements were obtained to assist in determining repeatability of levelness with each lift. Variations of 1/8" to 3/8" levelness were observed.

3. Fuel Inventory

   - Reviewed data from the dosimeter at the spent fuel pool demineralizer area.
   - Completed the camera inspection under the core support plate and taped the results.

4. Future Failure Detection Plan

   - Received NWT Corporation report.

FUEL RESOLUTION PROJECT

July 29, 1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   - Evaluate new I replacement candidates and develop a revised loading pattern (physics, safety analysis, fluence effects considered). Plant PRC is tentatively scheduled for Monday (8/2) to review the final loading plan. The NRC conference call on fuel failure and final reload plan should be scheduled after this.

2. UGS

   - Begin the UGS fuel alignment plate pin replacement.

3. Fuel Inventory

   - Vacuum shroud to quantify the amount of fuel on the shroud.
   - Detailed review of the video tape of the inspection below the core support plate.
   - Continue evaluating data from the spent fuel pool demineralizer area.

4. Future Failure Detection Plan

   - Complete review of the NWT report.
   - Begin drafting a fuel failure detection plan.

REVISED

FUEL RESOLUTION PROJECT
July 30, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   - All 16 revised I assembly replacements (L bundles) were visually inspected. Physics, fluence and safety analysis effects were evaluated in the development of a revised core loading pattern. NRC questions and general areas to be addressed at a future conference call were received. Discussion took place between CPCo and the NRC and between CPCo and Siemens Power concerning 50.59 of the revised reload plan. We understand the NRC's position and concerns and will be prepared to address these issues as we move through the reload and ultimately before we start up.

2. UGS

   - Began preparations for upper guide structure fuel alignment plate pin replacement.

3. Fuel Inventory

   - Continued to evaluate data from the dosimeter at the spent fuel pool demineralizer area.
   - Continued to smear fuel assemblies.
   - Rescheduled the vacuuming of the core shroud in the B-19 area until early next week.

4. Future Failure Detection Plan

   - Reviewed NWT report.

FUEL RESOLUTION PROJECT
July 30, 1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   - Review the video tapes of the L bundle inspections and complete the reload plan. If all looks good, reconstitution of the L bundles with stainless steel corner rods will commence and continue throughout the weekend.

2. UGS

   - Replace the UGS fuel alignment plate pin at core location Z-11 (North).

3. Fuel Inventory

   - Continue evaluating data.

4. Future Failure Detection Plan

   - A representative from the Big Rock Point Chemistry Department will be on-site to discuss the fissions/second analysis and how it can be applied at Palisades.

FUEL RESOLUTION PROJECT
July 31, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

One L fuel bundle has been reconstituted with stainless steel rods.

2. UGS

Continued with set-up of EDM tooling to cut off UGS alignment pin Z-11 (North) nut and upper pin length. Some tooling interferences were encountered and are being resolved.

3. Fuel Inventory

Surveyed the 602' elevation pipeway and the upper West Engineered Safeguards Room. No hot spots were identified.

4. Future Failure Detection Plan

Reviewed the Source Term Analysis method of detecting fuel failure with Big Rock Point personnel who have used it before.

July 31,1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   Continue review of the video tapes of the L bundle inspections.

   Continue reconstituting L fuel bundles.

   Continue working on the root cause determination.

2. UGS

   Continue to replace UGS alignment pin Z-11N.

3. Fuel Inventory

   Vacuum the shroud area in the B-19 location.

   Obtain a sample from the bottom of the reactor vessel.

4. Future Failure Detection Plan

   Continue to evaluate and test the Source Term Analysis method of detecting fuel failure.

FUEL RESOLUTION PROJECT
August 1, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   Additional L bundle reconstituted with Stainless steel rods.

2. UGS

   Resolved UGS Fuel Alignment Plate pin replacement tooling interferences. The Z-11N (North) pin nut and upper shank were removed with Electro-Discharge Machining (EDM).

3. Fuel Inventory

   Two additional area surveys completed; no unusual results uncovered.

4. Future Failure Detection Plan

   No information available this morning.

FUEL RESOLUTION PROJECT
August 1, 1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   Continuing with reconstitution of L bundles.

2. UGS

   Continue with UGS Fuel Alignment plate pin Z-11N replacement and gaging.

3. Fuel Inventory

   Vacuum shroud, B-19 location in particular.
   Sample debris below core support structure in Reactor Vessel lower head region.
   Continuing with surveys.

4. Future Failure Detection Plan

   No information available this morning.

FUEL RESOLUTION PROJECT
August 2, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

Reconstitution of L assemblies is underway. Four of the 16 assemblies were complete as of 0800 today. A revised assembly list and selection criteria is attached.

An inspection of the reactor cavity side tilt pit was performed and a piece of cladding may have been found.

2. UGS

UGS fuel alignment pin Z-11(North) was removed.

3. Fuel Inventory

A sample of the foreign material seen on the reactor bottom was retrieved. Preliminary observation indicates it is similar to the substance obtained by smearing fuel assemblies.

The vacuuming of the core shroud was again postponed because of the lack of crane availability due to the UGS pin replacement process.

Future Failure Detection Plan

Continued testing of the Source Term Analysis method of fuel failure detection.

August 2,1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

Reconstitution efforts will continue.

The PRC is scheduled to meet at 1300 hrs today to review the revised reload plan. A telephone conference is planned for 1400 hrs tomorrow to discuss this same subject and to answer specific NRC questions.

Additional tilt pit inspection to positively identify the foreign material seen in the reactor cavity tilt pit (thought to be a piece of cladding) and develop a recovery plan if it is the missing cladding.

Clarification regarding the 50.59 evaluation of the reload during today's 1600 hrs telephone conference.

2. UGS

Continue with replacement of Z-11 (North) pin and functionality gaging of that pin once it is replaced.

3. Fuel Inventory

Vacuum the shroud to obtain sample material form the area adjacent to the B-19 location (timing depends on crane availability).

Continue to smear assemblies as they become available in the SFP elevator.

4. Future Failure Detection Plan

Continue testing of the Source Term Analysis method.

Review Connecticut Yankee's fuel failure detection procedure and INPO Good Practice T3-409 for applicability to Palisades.

ASSEMBLY EXPOSURE(MWD/MTU)

L-02	36,570	L-14	30,446
L-05	36,570	L-16	30,446
L-08	36,570	L-18	30,446
L-11	36,570	L-20	30,446
L-13	30,705	L-33	37,709
L-15	30,705	L-51	37,709
L-17	30,705	L-55	37,709
L-19	30,705	L-56	37,709

ACCEPTANCE CRITERIA:

1. BURNUPS < 37,500 MWD/MTU AT EOC FOR J AND K ASSEMBLIES ONLY

   Somewhat arbitrary and less important if L Bundles used, however attempt was to stay < I-024 BOC Burnup when I-024 was not yet failed. Design Limit of 46,000 MWD/MTU for L assemblies still applicable due to different design on spacer grid.

2. Not Previously on of the eight octant symmetric corner shroud position that I-024 was in when failed.

   Conservative perhaps to apply all 8 locations. Definitely want to avoid previous X-19, B-19 residence bundles in case some damage already invoked on bundles.

3. Bundle Bow not excessive in relation to I-024 flux gradient

   Bundle/shroud interference is already at B-19 and X-19 locations. Bundle bow towards shroud may add to problem. Bundle bow away from shroud at BOC must consider potential impact on adjacent control rod.

4. L assemblies may have some advantage over J & K assemblies.

   Spacer Plate Material was stamped in preferential directional to minimize cell opening due to growth. Also using L will not require UT where as J and K assemblies will require UT.

5. Fluence rate values should not exceed Cycle 9 values.

   Cycle 9 fluence rates were used for the current PTS submittal being reviewed by the NRC.

Palisades Fuel Failure and Reload Plan

Conference Call 8/3/93

Agenda

I. Fuel Inspection Summary

II. Root Cause Analysis Summary

III. "I" Replacement Assembly Selection Criteria

IV. Revised Cycle 11 Core Configuration

V. Reload "O" and Cycle 11 Licensing Considerations

VI. Failed Fuel Rod Accountability and Impact on Fuel Integrity During Cycle 11 Operation

I-024 FAILED ROD EVENT INSPECTION RESULTS SUMMARY

1. 7-1-93 0930 INSPECTION OF UNKNOWN ITEM

Unknown item inspected in south tilt pit using camera and known OD plug to determine its OD.

RESULTS: Item appears to be a piece of fuel rod, about 5 feet long.

2. 7-1-93 2100 TILT PIT AREA INSPECTION

Accessible areas of the reactor cavity tilt pit were inspected using a camera to determine if other pieces existed.

RESULTS: 4 pieces found totaling about 11 feet; one had a lower end cap. Total length of one of the pieces could not be positively estimated, since it was not entirely visible.

3. 7-2-93 A-SHIFT INSPECTION OF LOWER END CAP

Camera inspection of lower end cap was performed in an attempt to identify its serial number.

RESULTS: Serial number was read and later that morning was identified to belong to assembly I-024 corner rod S-15.

4. 7-4-93 A-SHIFT DETAILED EXAM OF ROD PIECES BY SIEMENS

Rod pieces were moved to the south end of the tilt pit and a detailed examination was performed. Only 3 pieces were located at this time. Total length is still approximately 11 feet. Fourth piece that CPCo saw earlier was not found. At this time it was postulated that CPCo had mistaken a hose and shadows for a rod piece.

RESULTS: The three pieces were characterized in detail. Big picture results are:

a. One piece has a severe longitudinal split with an estimated 5 feet of fuel missing.
b. Severe wear exists at spacer locations.
c. Upper end cap not located.
d. One 18 inch piece appears to contain fuel.
e. No obvious fuel pellets seen on the floor.

5. **7-4-93 C-SHIFT TO 7-5-93 A-SHIFT FRAGMENTED ROD RECOVERY**

Siemens retrieved the rod pieces and placed them in storage baskets. Visuals were made of the process.

RESULTS: One end of the 4 1/2 foot piece verified visually to contain fuel. The larger 5 foot piece appeared to be more than just split. Likely cladding material is missing from this piece. The 4 1/2 foot piece fit well to the 18 inch piece.

6. **7-5-93 A-SHIFT REFUELING MACHINE HOIST BOX INSPECTION**

A camera inspection of the refueling machine hoist box was performed to check interior for damage or protrusions.

RESULTS: Completed with no damage found.

7. **7-6-93 B-SHIFT TILT MACHINE CARRIER INSPECTION**

A camera inspection of the tilt machine carrier was performed to check interior for damage or protrusions.

RESULTS: Completed with no damage found.

8. **7-6-93 1800 REVIEW OF EARLIER I-021 VISUAL EXAM**

The video tape of I-021 visual exam performed earlier in the refueling outage was reviewed in light of the problem with I-024.

RESULTS: The corner rod of I-021 that was located next to the core shroud was observed to be loose at spacer number 7. The is the equivalent position to I-024 failed rod.

9. **7-8-93 REVIEW OF I-021 AND I-024 VISUALS TAKEN DURING CYCLE 8**

The video tape of I-021 and I-024 that was taken during cycle 8 to support the I-Hafnium installation project was reviewed.

RESULTS: No observed problems seen.

10. **7-12-93 REVIEW OF LAST REFUELING I-021 AND I-028 VISUALS**

The video tape of last refueling outage visual of I-021 and its sister assembly I-028 was received from Siemens and reviewed.

RESULTS: No observed problems seen.

11. **7-12-93 I-024 IN CORE INSPECTION**

View of I-024 from the top as it sat in the core after the UGS removal was taped.

RESULTS: No observed damage or markings to note on the upper tie plate. A piece of spacer side plate of about 1/4 inch width was located on the shroud. (This piece was later vacuumed up.)

12. **7-13-93 I-024 IN CORE INSPECTION PRIOR TO REMOVAL**

View of I-024 as it sat in the core prior to removal and the piece that fell from the bundle as it was move to the tilt machine was taped.

RESULTS: The observed damaged was documented in detail. Big picture results are:

a. Severe spacer damage exists.
b. The dropped piece was the upper end of the failed rod and accounts for the remainder of the failed rod's length.
c. The assembly was judged to be acceptable for transport to the spent fuel pool using the normal refueling equipment.

13. **7-13-93 DETAILED VISUAL OF I-024 IN THE SPENT FUEL POOL**

A detailed visual of all four sides of I-024 was performed.

RESULTS: The observed damage was documented in detail. Big picture results are:

a. Spacers 1-5 appear freshly torn.
b. Spacers 6-9 have corner material missing. These spacers show a failure mechanism apparently different than the first five spacers, (as determined by oxide, rub marks, and failure locations).
c. Adjacent rods to the failed position show fretting within span 9, suggesting the failed rod was severed partially or completely in this span during operation.
d. A fuel plume was observed starting near the top of span 9.

14. **7-13-93 VISUAL AND RETRIEVAL OF THE ROD PIECE ON THE CORE**

The rod piece that fell from I-024 during its transit to the tilt machine was retrieved while being taped. It was placed in the storage basket along with the remaining fragmented rod pieces.

RESULTS: This piece was about 6 inches long and seemingly would have fit well with one end of the 5 foot long piece.

15. **7-14-93 VISUAL OF I-021**

A visual exam of I-021 was performed with particular emphasis to have corner rods well focused.

RESULTS: Loose rods observed as well as rod S-1 had large wear marks at spans 5 and 6 on both sides A and B which would have been in the core shroud corner during cycle 10 operation.

16. **7-15-93 I-024 INDIVIDUAL ROD EXAMS**

Individual rods from I-024 were examined for withdrawal force, eddy current testing, and visual examinations. The 3 rods adjacent to failed rod S-15 were not examined due to spacer cell damage.

RESULTS: Corner rods on sides adjacent to the shroud during Cycle 10 had several indications of up to 12 mil depth from fretting at the spacer cell locations.

17. **7-16-93 I-021 INDIVIDUAL ROD EXAMS**

Individual rods from I-021 were examined for withdrawal force, eddy current testing, and visual examinations.

RESULTS: Corner rods on sides adjacent to the shroud during Cycle 10 had several indications of up to 12 mil depth from fretting at the spacer cell locations. The visual on rod S-1 confirmed rubbing wear at spans 5 and 6 from the shroud corner during Cycle 10 operation.

Note: At this time, the decision was made not to re-use the I-Hafnium assemblies in Cycle 11. Inspections for root cause continued with emphasis on ability to justify use of replacement bundles.

18. **7-17-93 I-048 EXAMINATION**

An assembly visual of I-048 was performed as well as examinations of selected individual rods for withdrawal force, eddy current testing, and visual examinations. This bundle was in core location B-19 during the previous Cycle 9. Also, rod selection pattern for individual rod examinations was modified to better check status of interior rods.

RESULTS: Assembly visual overall looked good. Corner rods on sides adjacent to the shroud during Cycle 9 or 10 had several indications of up to 6 mil depth from fretting at the spacer cell locations. Interior rods all looked good.

19. **7-18-93 J-021 AND K-031 EXAMINATIONS**

Potential replacement candidates J-021 and K-031 were examined. Assembly visuals were performed as well as examination of individual rods.

RESULTS: Assembly visuals overall looked good. Corner rods and interior rods looked good. Only one minor indication seen on each assembly.

20. **7-18-93 H-031 EXAMINATION**

An assembly visual of H-031 and an examination of selected individual rods was performed. This bundle had resided in core location B-19 during Cycle 8. Cycle 8 was its fourth cycle of burn. EOC 8 burnup was 37,625 MWD/MTU. Also, H-031 never saw the increased PCS flow that resulted from the S/G replacement that occurred at EOC 8.

RESULTS: Assembly visual indicated one side may have been rubbing against the core shroud during Cycle 8. Corner rods on a side adjacent to the shroud during Cycle 8 had several indications of up to 8 mil depth from fretting at the spacer cell locations. Additional, a corner rod that was not on the core shroud had several indications of up to 8 mil depth from fretting at the spacer cell locations.

21. **7-19-93 L-024 EXAMINATION**

An assembly visual of L-024 and an examination of selected individual rods was performed. This bundle resided on the core shroud between bundles I-048 and I-024 during Cycle 10.

RESULTS: Assembly visual and individual rod exam results were good.

22. **7-19-93 L-054 EXAMINATION**

An assembly visual of L-054 and an examination of selected individual rods was performed. This bundle had the highest 3 cycle core residence burnup of all standard bundles, 37,709 MWD/MTU. Also, L-054 had never resided on a core shroud location.

RESULTS: Assembly visual and individual rod exam results were good. Two minor indications were seen on one rod.

23. **7-20 & 21-93 L-059 AND L-060 EXAMINATIONS**

Lead High Thermal Performance (HTP) spacer design assemblies L-059 and L-060 were examined to check performance of spacer design that affects the majority of Cycle 11 core design. Assembly visuals and individual rod examinations were performed.

RESULTS: Assembly visuals and individual rod exam results were good. Some minor indications were seen on a few rods.

24. **7-21-93 I-025, I-027, I-028, AND I-052 EXAMINATIONS**

Assembly visuals on these 4 I-Hafnium assemblies were performed to check for any indications of rubbing or damage.

RESULTS: Loose corner rod(s) was(were) seen in assemblies I-025 and I-027.

25. **7-26-93 M-048 AND M-049 EXAMINATIONS**

Assembly visuals on M-048 and M-049 were performed to check for any indications of damage. These two assemblies plus the previously examined I-025 were adjacent to I-024 during Cycle 9. The Cycle 9 core loading indicated some difficulty about this area.

RESULTS: Assembly visuals showed no handling damage.

26. **7-22-93 CORE LOCATION B-19 VISUAL**

Core location B-19 where I-024 resided during Cycle 10 was visually examined.

RESULTS: Rub marks from assembly I-024 evident. Guide bar rub marks heavier on west side and spacer rub marks heavier on south side. Rub marks from S-15 corner rod evident from assembly spans 5 through 9.

27. **7-23-93 CORE LOCATION X-19 VISUAL**

Core location X-19 where I-021 resided during Cycle 10 was visually examined.

RESULTS: Rub marks from assembly I-021 evident. Rub marks from S-1 corner rod evident from assembly spans 5 and 6.

28. **7-27-93 I-056, J-056, AND K-056 EXAMINATIONS**

These assemblies resided in core location B-19 during Cycles 5, 6, and 7, respectively. Minor wear due to interfacing with the shroud likely would not be seen due to two subsequent cycle burns for each of the assemblies. However, significant wear or damage seen may help determine whether shroud/assembly interfacing issue is an old problem.

RESULTS: No conclusive evidence of shroud rubbing seen. I-056 did have a damaged spacer grid, however, the damage appeared unrelated to the I-024 failed rod issue.

29. **7-28-93 SAN-08, I-021, AND L-052 LENGTH MEASUREMENTS**

Length measurements of these bundles were made to verify growth within design expectations.

RESULTS: Length measurements were within design expectations and, more importantly, were not indicating growth necessary to interfere with UGS bottom plate.

30. **7-29-93 CORE LOCATION B-5 VISUAL**

Core location B-5 was where I-025 resided during Cycle 10. This core location visual was to see what a potentially "good" corner shroud location looked like, since I-025 visual did not indicate any interference rubbing.

RESULTS: Rub marks evident from I-025 guide bar span 9 on the north side. Spacer 9 may have also been rubbing.

31. **7-30-93 REPLACEMENT ASSEMBLY VISUALS**

Assembly visuals were performed on 16 assemblies selected as candidate replacements for the I-hafnium assemblies.

RESULTS: All found to be acceptable.

Root Cause Status Summary
I-024 Failed Rod Event

8-2-93

A. Potential Root Causes That Have Been Eliminated

1. Damaged during fuel moves during previous cycle - tilt machine problem, refueling machine problem, operator error, or handling event.

   Reasons Eliminated:

   a. No documentation found to support this cause.
   b. Snag hazards or damage on the tilt machine carrier and refueling machine hoist box not found.
   c. I-024 was rubbing against the core shroud during Cycle 10 operation.

   Conclusion:

   This causal factor was not the root cause. The possibility exists that this causal factor contributed to the event perhaps adding to the damage that I-024 received.

2. Damaged during EOC 9 UT inspection.

   Reasons Eliminated:

   a. No documentation found to support this cause.
   b. S-15 rod was not in the corner held by the UT clamp.
   c. Damage to UT rig likely occurred due to lifting the base plate, not due to a fuel bundle, per (SPC) Siemens Power Corp.
   d. UT rig potentially affects the bottom of a fuel assembly, just above spacer number 1. I-024 damage occurred between spacers 5 and 10.
   e. I-024 was rubbing against the core shroud during Cycle 10 operation.

   Conclusion:

   This causal factor was not the root cause and likely was not a contributing factor.

3. Damaged during fuel moves this refueling - tilt machine problem, reactor machine problem, core structural interference problem, or operator error.

   Reasons Eliminated:

   a. Inspection of tilt machine and refueling machine hoist box showed no damage or snag hazards.
   b. No documentation to support these casual factors.
   c. Rod S-15 was failed during Cycle 10.
   d. I-024 was rubbing against the core shroud during Cycle 10 operation.

Conclusion:

These causal factors were not the root cause and likely were not contributing factors.

4. Fuel failure due to loose spacer grid.

Reasons Eliminated:

a. B-19 and X-19 core locations showed that an interference with spacers is occurring.
b. B-19 core location showed guide bars above spacer 10 were in contact with the shroud.

Conclusion:

This causal factor was not the root cause. However, it may have been a contributing factor. Spacer grid design must be addressed sufficiently to justify no concern exists for the replacement bundles.

B. Potential Root Causes That Are Considered Unlikely

1. Fuel failure due to increased PCS flow.

Reasons Considered Unlikely:

a. H-031 inspections showed evidence of interference with shroud at its Cycle 8 B-19 core location. S/G replacement and increased flow occurred after Cycle 8.
b. Inspections of other non-I Hafnium bundles that have resided in the core during Cycle 9 and 10 showed no problems.
c. Core location B-19 inspection showed I-024 guide bars above spacer 10 were in contact with the shroud.
d. Flow at peripheral core locations is 6% lower than flow in the center, but only problems at the peripheral locations seen.

Conclusion:

This causal factor is considered unlikely to be a root cause. However, it may be a contributing factor. Reactor noise analysis may help indicate likelihood of being contributing factor.

2. Fuel failure due to core barrel vibration.

Reasons Considered Unlikely:

a. L-024 inspection results showed no problem.
b. Core location B-19 inspection showed I-024 guide bars above spacer 10 were in contact with the shroud.

Conclusion:

This causal factor is considered unlikely to be a root cause. However, it may be a contributing factor. Reactor noise analysis may help indicate likelihood of being contributing factor.

3. Fuel failure due to manufacturing failure.

Reasons Considered Unlikely:

a. I-024 has severely damaged spacer grids at the corner.
b. Manufacturing failure normally would show up earlier in operating history.
c. B-19 and X-19 core locations showed that an interference with spacers is occurring.
d. B-19 core location showed guide bars above spacer 10 were in contact with the shroud.
e. Manufacturing records reflected no associated problems.

Conclusion:

This causal factor was not the root cause and likely was not a contributing factor.

C. Potential Root Causes That Are Considered Likely

1. Fuel failure due to shroud problem.

Reasons Considered Likely:

a. Core locations X-19 and B-19 showed that an interference with spacers is occurring.
b. B-19 core location showed guide bars above spacer 10 were in contact with the shroud.
c. I-024 has severely damaged spacer grids at corners, with spacers 6 through 9 likely failed due to fretting.
d. I-021 showed evidence of interference with shroud at core location X-19.

Conclusion:

This shroud/bundle interface problem really is considered the likely proximate cause. True root cause(s) must still be determined considering potential contributing factors.

Root cause might be: 1. shroud distortion from operating conditions/cycling, 2. shroud distortion due to loose or broken bolting, 3. misalignment between UGS and core support barrel, or 4. problem always existed from original as-built conditions, however, addition of some contributing factors was required to obtain the conditions to cause the I-024 failed rod event.

Contributing factors might be: 1. I-024 was burned 5 times, 2. minor damage on I-024 may have existed from a handling event, 3. I-024 loose spacer grids, 4. increased PCS flow due to S/G replacement after Cycle 9, 5. core barrel vibration changes, 6. localized PCS flow changes due to introduction of (HTP) High Thermal Performance fuel bundles, 7. fuel bundle bow, or 8. fuel bundle twist.

Recommended Actions With Respect To Root Cause Determination:

A. For potential root causes 1 and 2, visual inspections already confirmed no gross distortion exists and bundle inspections imply condition may have existed at least since Cycle 8. Following further actions are recommended:

   1. Perform assembly visuals on remaining 10 I-Hafnium assemblies when they are removed from the core to assure remedial corrective action modifications being made to replacement bundles remains bounding.

   2. Performed already planned inspections of any core locations associated with I-Hafnium assemblies that show signs of assembly/shroud interfacing.

   3. In future refueling when core offload performed, performed more detailed inspection of the core shroud.

B. For potential root cause 3, no further action beyond that ongoing by the UGS/Stuck Bundle root cause team.

C. For potential root cause 4, contributing factors need to be addressed to help assure failure of a rod does not occur during any future cycle. Following further actions are recommended:

   1. Don't burn a standard design bundle more that 5 cycles unless and until this factor can be eliminated as a possible contributor.

   2. Address spacer relaxation seen on the standard design bundles sufficiently to justify no concern exists for the replacement bundles.

   3. Evaluate replacement bundles for bundle bow with the criteria that interference with the core shroud is avoided or minimized.

   4. Perform a qualitative evaluation of B-19 core location localized flow conditions with respect to the additional HTP bundles in Cycle 11 to attempt to address impact, if any.

   5. Review parts reactor noise analysis of Cycles 8,9, and 10 for changes or trends.

Inspection Plans For I-024 Failed Rod Event

Visually Inspect Core Locations B-19 & X-19

Reason: Locations where I-024 & I-021 resided, respectively. Looking for gross shroud distortion, rub marks from bundles, core plate obstructions & check for proper seating.

Review Period for Data Collected To Date

Reason: To determine if sufficient data has been obtained with respect to the root cause evaluation to enable decision on appropriate remedial corrective action required to cover operation of Batch J,K or L Bundles for one cycle as replacements to the I-Hf.

Bundle Selection Process

Objective: Selection criteria that was to be considered is attached, 4 items. Additionally, if J,K & L were evently matched, L would be preferred to avoid need to UT replacement bundles that might have been desired on J&K.
Reason: J&K operated one & two cycles respectively after being UT'd or sipped. L's were in for Cycle 10 which showed no typical defects from average powered fuel rods.

See pg 2, Selected Bundle Visuals

From Page 1

≈

Selected Replacement Bundle Visuals

Reason: To verify no assembly damage that would disqualify reuse (example: spacer damage) and perhaps affect use of its symmetric assemblies.

Swap 14 Rods in each Replacement Bundle Per Attached Plan with S.S.

Reason: Corner of assembly with 8 S.S. replacement rods would be placed towards shroud corner. Fuel rod fretting is avoided. If spacers fretted through like I-024, corner rod would likely remain in place, captured by spacers 1-5 and 10. For other 3 assembly corners, one S.S. rod of 0.437" OD could replace one fuel rod, tightening up entire 4 cell corner area which shares a common lantern spring. Two S.S. rods per corner was selected to place evently distributed load on affected rods.

In parallel with the above activities, Pages 3&4 provides inspection items which pertain to root cause investigation of either I-024 failed rod event and/or UGS/SAN-08 stuck bundle event. Root cause inspection items are prioritized above the remedial action of replacement bundles when possible.

SAN-08 Length Measurement	Reason:	To verify growth was as predicted per design calcs.
Replace SAN-08 Upper Tie Plate	Reason:	Use of a modified upper tie plate is seriously being considered as an insurance step to possibly help avoid future sticking to UGS.
I-021 Length Measurement	Reason:	To verify assembly growth was as predicted per design calcs. Should be representative of I-024 too. Prefer to handle I-021 verse damaged I-024 for this item.
L 052 Length, Assembly Visual including better look at lower tie plate pins	Reason:	Bundle required high extraction force to remove at beginning of present refueling outage. Lean during removal process raises question as to how much of one of its lower tie plate pins was inserted into core support plate. If up 0.69", then possible linking to I-024 event may exist if UGS positioning affected.
Visually Inspect Core Locations B-5 & X-5	Reason:	These are locations where I-025 & I-028 resided during Cycle 10. No noticeable rubbing was seen on these bundles. Desire here is to see what potentially "good" corner shroud location look like.

Assembly Visuals on Remaining 10 I-Hf Assemblies When They Are Removed From The Core

Reason: Further root cause data input to see if other locations affected. Also, needed to assure any remedial modification corrective action taken to replacement bundles (S.S. rod placement pattern) remains bounding

Visually Inspect Any Core Locations Associated With I-Hf Assemblies That Shows Signs of Assembly/ Shroud Interfacing

Reason: To better characterize interfacing and to perhaps assist in root cause determination.

Assembly Visuals on I-56, J-56 and K-56

Reason: Assemblies were located at core location B-19 during Cycles 5,6 & 7, respectively, as new bundles. Minor wear due to interfacing with shroud likely not possible to see due to each burned in core 2 subsequent cycles. However, significant wear or damage may help determine whether the shroud/ bundle interfacing issue is an old problem.

1993 UGS ROOT CAUSE

SUMMARY - AUGUST 11, 1993

Selection Criteria For I-Hf Replacements

1. Burnups < 37,500 MWD/MTU at EOC 11 for J and K Assemblies

   Reason: Somewhat arbitrary & less important if L Bundles used, however, attempt was to stay < I-024 BOC 10 Burnup when I-024 was not yet failed. Design Limit of 46,000 MWD/MTU for L Bundles still applicable due to different spacer grid stamping.

2. Not previously on one of the eight octant symmetric corner shroud position that I-024 was in when failed.

   Reason: Conservative perhaps to apply to all 8 locations. Definitely want to avoid previous X-19 and B-19 residence bundles in case some damage already invoked on bundles.

3. Consider Bundles Bowing in the Selection criteria to avoid largely bowed assemblies.

   Reason: Bundle/Shroud interference is already at B-19 and X-19 locations. Bundle bow towards shroud may add to problem. Bundle bow away from shroud at BOC must consider potential impact on adjacent Control Rod.

4. L assemblies may have some advantage of J & K assemblies.

   Reason: Spacer Plate Material was stamped in preferential directional to minimize cell opening due to growth. Also using L will not require UT where as J and K assemblies will require UT.

5. Fluence rate values should not exceed Cycle 9 values.

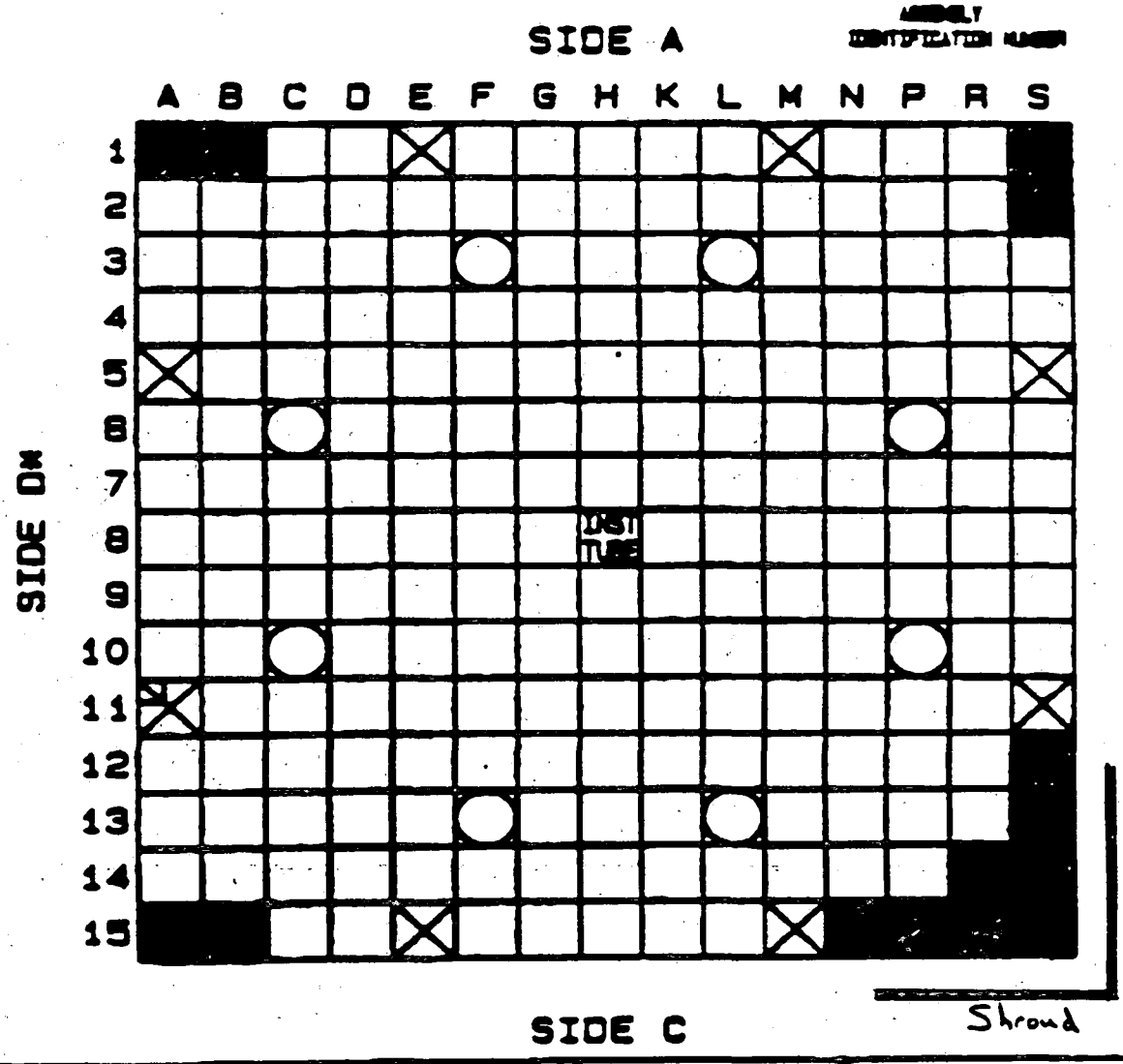
   Cycle 9 fluence rates were used for the current PTS submittal being reviewed by the NRC.

CONVENTION FOR IDENTIFYING FUEL ROD POSITIONS IN GUIDE TUBE ASSEMBLIES

EXXON NUCLEAR COMPANY, INC.

FUEL ASSEMBLY MAP

REACTOR: PALISADES WITH BURNABLE POISON		ASSEMBLY VIEW: TOP
ASSEMBLY NUMBER:	MATRIX: 15 X 15	REACTOR TYPE: PWR



GENERAL NOTES:

- BURNABLE POISON ROD
- ORIENTATION NOTCH ON BURNABLE POISON ROD AT POSITION A-15
- GUIDE TUBE

SPACER SERIAL NUMBERS: SPACER TYPE

SPACER	TYPE
L, S	A
S	B
M	C
N	D

XN-FP-1ST UDOSS REV. 0

REFERENCE DRAWING: FUEL BUNDLE ASSEMBLY: XN-NF-303, 305

■ ⇒ S.S. Rod

CYCLE 11 CORE CONFIGURATION

1. 16 L ASSEMBLIES THAT RANGE FROM 30,400 MWD/MTU TO 37,700 MWD/MTU. QUARTER CORE MAP SHOWS ASSEMBLY LAYOUT.

2. ASSEMBLIES ROTATED SO BOW WILL BE IN TOWARDS CORE. EIGHT ARE PLACED NEXT TO CONTROL RODS. MAXIMUM PROJECTED GRADIENT AGAINST CONTROL ROD IS APPROXIMATELY 4600 MWD/MTU. CONTROL RODS HAVE SEEN GRADIENTS AS HIGH AS 7000 MWD/MTU WITHOUT INTERFERENCE. CLEARANCES BETWEEN FUEL ASSEMBLY, CONTROL ROD AND SHROUD;

   - FUEL ASSEMBLY GUIDE BAR AND SHROUD = 0.1365 INCHES
   - FUEL ASSEMBLY GUIDE BAR AND CONTROL ROD = 0.0625 INCHES

3. EXPECTED CYCLE 11 EXPOSURE INCREASE IS 2500-3200 MWD/MTU.

4. CYCLE LENGTH INCREASED FROM 414 EFFECTIVE FULL POWER DAYS(EFPD) TO 420 EFPD.

5. TECH. SPEC. Fr^T, Fr^A (PEAK ROD/ASSEMBLY POWER) LIMIT = 1.95 AND 1.69

   CYCLE 11 Fr^T = 1.845 @ 100 MWD/MTU(Assumes 5% Design Margin)

   Fr^A = 1.58 @ 100 MWD/MTU(Assumes 5% Design Margin)

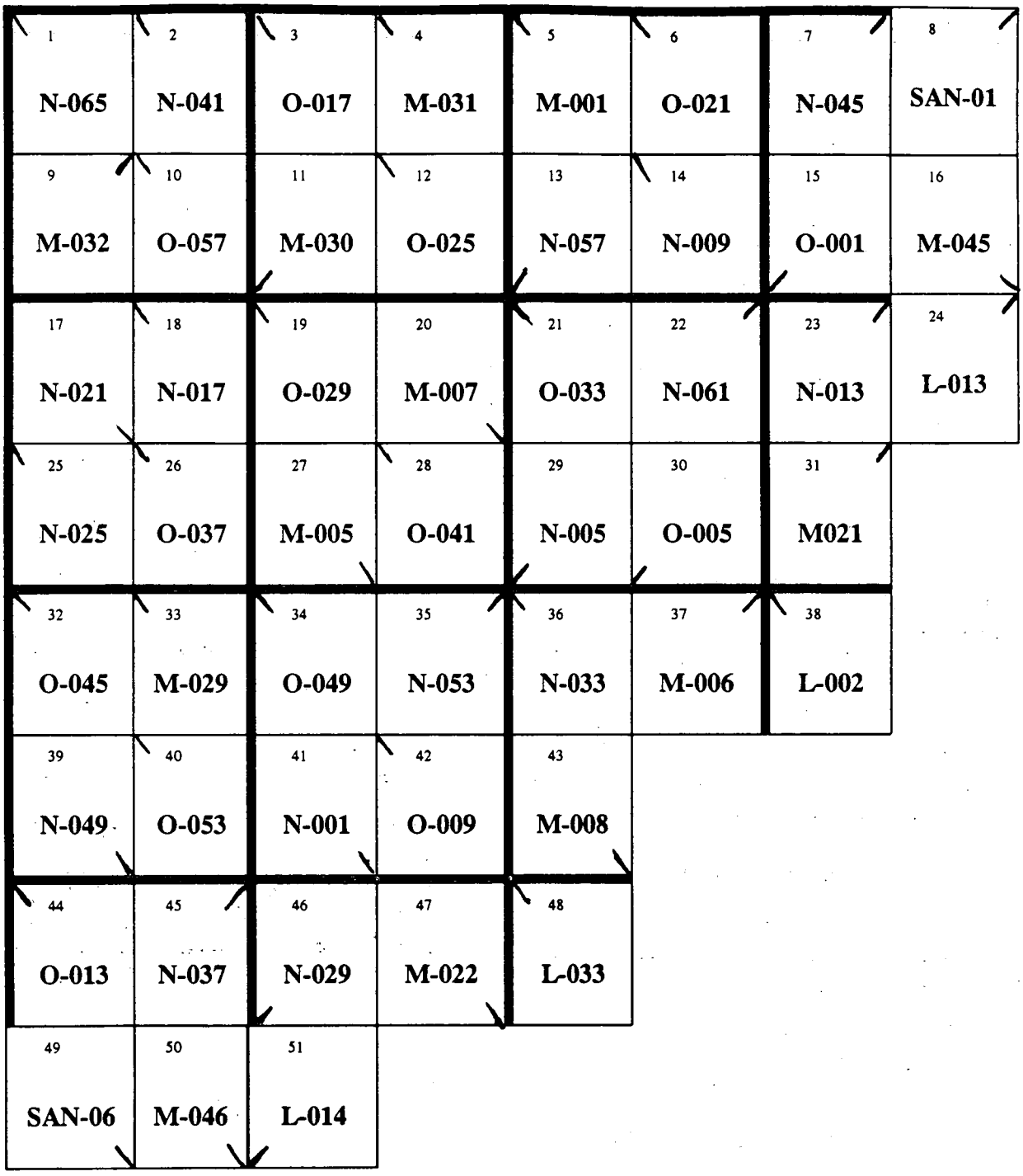
6. POWERS ON PERIPHERAL LOCATIONS ARE LESS THAN OR EQUAL TO CYCLE 9 RESULTING IN FLUENCE RATES BEING ABOUT THE SAME AS CYCLE 9.

PALISADES FLUX (E>1.0MeV) n/cm^2/s

Cycle	Cycle Length	0 Degrees	16 Degrees	30 Degrees
9	298	2.09E+10	3.05E+10	1.99E+10
11*	420	1.38E+10	2.23E+10	1.72E+10

*Values are preliminary scoping values.

CYCLE 11 REVISED CORE CONFIGURATION



CYCLE 11 REVISED
QUARTER CORE MAP

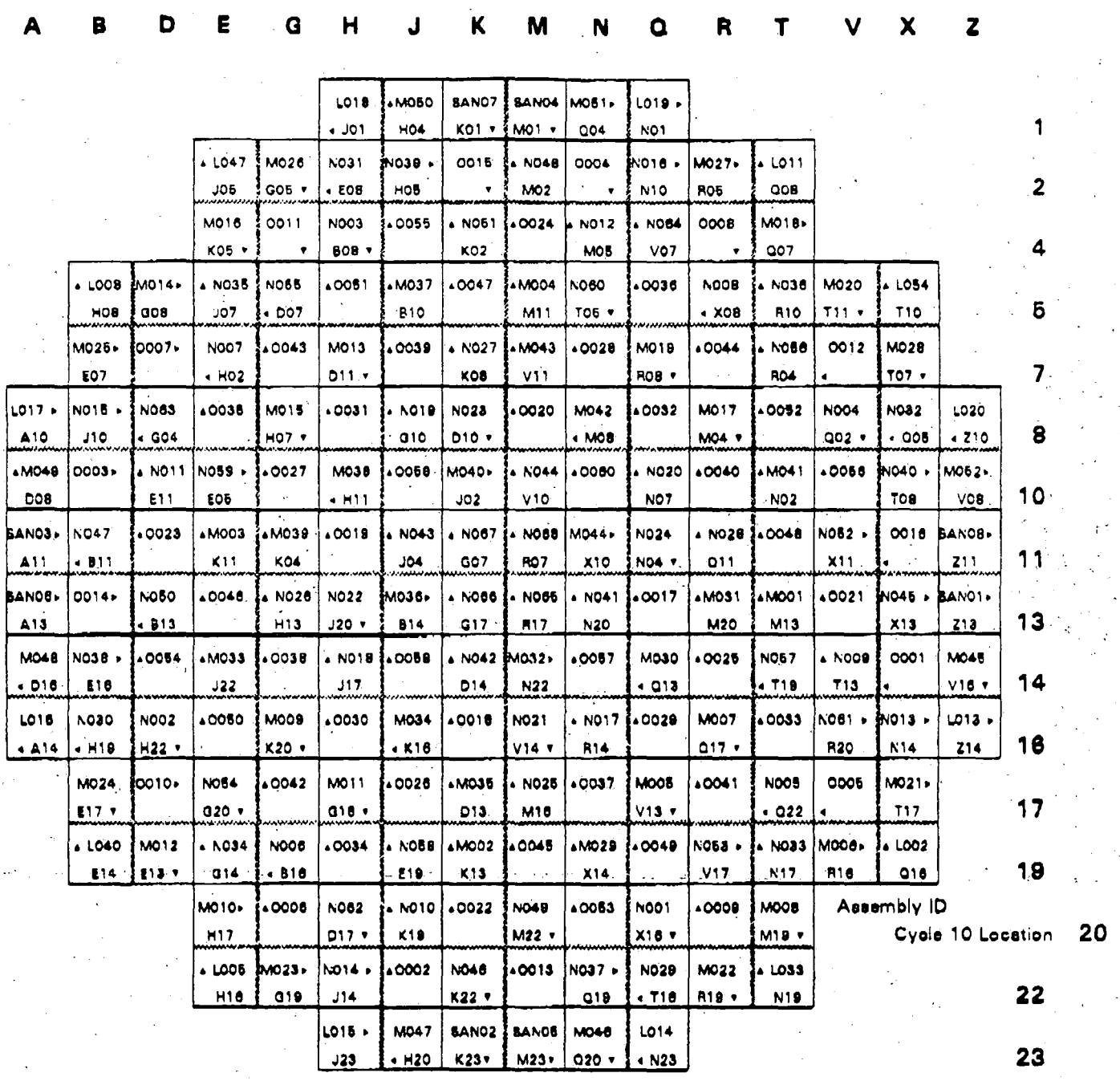


Figure 1 - Palisades Cycle 11 Full Core Loading Pattern

RAPIFAX NO. 11
PAGE 2 OF 2

FUEL RESOLUTION PROJECT

August 3, 1993

Summary of Activities Performed in the Last 24 Hours

Revised

1. Fuel Failure

   Reconstituted two more fuel assemblies. A total of six are now complete.

2. UGS

   A new pin was inserted in the Z-11 North position ~~(the nut was not installed)~~ and the functionality gage did not fit. Therefore, the second fuel alignment pin (Z-11 South) is in the process of being removed. 1

3. Fuel Inventory

   Smeared two more fuel assemblies and found material similar to that found on other bundles and in the reactor bottom.

4. Future Failure Detection Plan

   Continued work on the Source Term Analysis spreadsheet.

   Continued review fuel integrity procedures from Connecticut Yankee and Trojan.

   Contacted Siemens for assistance in modifying our fuel failure detection plan.

Activities Planned for the Next 48 Hours
August 3, 1993

1. Fuel Failure

   Continue to reconstitute fuel assemblies to replace the I bundles.

2. UGS

   Complete installation of UGS alignment pins at location Z-11 and start removal of the degraded pin at location Z-16.

3. Fuel Inventory

   Review our recovery process with Greg Eidam of Bechtal Environmental - Oak Ridge.

   Vacuum the core shroud at the B-19 location to obtain a material sample and compare it to material obtained by smearing fuel assemblies and to material from the reactor bottom.

4. Future Failure Detection Plan

   Continue testing the Source Term Analysis (STA) spreadsheet.

   Continue review of the Trojan and Connecticut Yankee procedures and the INPO T3-409 Good Practice.

FUEL RESOLUTION PROJECT

August 4, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   - Reconstituted two fuel assemblies. A total of eight are now complete.
   - Conducted a conference call with the NRC staff to review our fuel reload plan and the specific questions included in the August 3, 1993 NRC Request for Additional Information (RAI).

2. UGS

   - UGS fuel alignment plate pin Z-11 south was replaced.
   - Z-11 functionality gaging was satisfactory.

3. Fuel Inventory

   - Reviewed the video tapes with Bechtel representative.
   - Smeared two more bundles.
   - Vacuumed B-19 location - preliminary - no fuel recovered. Inspected filter attached to tilt pit drain line - minimum fuel present.

4. Future Failure Detection Plan

   - Completed review of Connecticut Yankee and Trojan Plant fuel reliability procedures.
   - Continued testing of source term plot spreadsheet.
   - Requested reviews of Palisades plant fuel reliability procedure by NWT. The evaluation is due August 5.
   - Evaluating the use of fission gases for source term plots.

FUEL RESOLUTION PROJECT
August 4, 1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   - Continue to reconstitute fuel bundles to replace the I bundles.

2. UGS

   - Begin removal of UGS fuel alignment plate pin Z-16 South.

3. Fuel Inventory

   - Continue working with Bechtel representative.
   - Attempt to get survey at T-50 (fuel pool demineralizer).
   - Review tape of shroud vacuuming.
   - Review survey data telecon from filter T-74 (dirty waste drain tank), T-80 (equipment drain tank), and T-60 (dirty waste drain tank).

4. Future Failure Detection Plan

   - Continue evaluation of the use of fission gases for source term plots.
   - Continue testing of source term plot spreadsheet.

FUEL RESOLUTION PROJECT
August 5, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   - Reconstituted the one L bundle. (nine complete).

2. UGS

   - UGS fuel alignment plate pin Z-16S has been removed and a new pin is being inserted.

3. Fuel Inventory

   - Reviewing collected data.
   - Planning fuel pool tilt pit survey.
   - Planning fuel pool demineralizer drain down and survey.

4. Future Failure Detection Plan

   - Continued evaluation of using fission gases on source term plots.
   - Continued updating the source term spreadsheet methodology.

FUEL RESOLUTION PROJECT
August 5, 1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   - Continue reconstituting L bundles for I bundle replacement.

2. UGS

   - Insertion of UGS fuel alignment plate pin Z-16S and functionally gaging.
   - UGS keyway and reactor vessel key gaging to begin after successful UGS fuel alignment plate pin installation.

3. Fuel Inventory

   - Two Bechtel fuel recovery specialists will arrive onsite to review our efforts to locate the fuel from I-24.
   - Perform spent fuel pool tilt pit survey.
   - Continue planning for the fuel pool demineralizer drain down survey.

4. Future Failure Detection Plan

   - Continue evaluation of using fission gases for source term plots.
   - Continue testing the source term plot spreadsheet methodology.
   - Receive evaluation of the Fuel Reliability Index (FRI) procedure by NWT (due 08/05/93).
   - Review NWT evaluation of the FRI procedure.

FUEL RESOLUTION PROJECT
August 6, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   - Resumed reconstitution activities and completed 2 more assemblies (11 of 16 total) after making corrective actions to fuel rod grapple techniques and briefing all crews.

2. UGS

   - UGS fuel alignment plate pin replacement at Z-11 North and South and Z-16 South locations are complete. Functionality gaging at both locations was satisfactory.

   - UGS fuel alignment plate pins at X-19 were also functionality gaged and were satisfactory. This location was gaged as a result of observing dimple marks on the upper tie plate of the I-045 fuel assembly. One dimple corresponds to the orientation of the UGS fuel alignment plate pin when the I-045 fuel assembly resided in core location X-19 (cycle 9).

3. Fuel Inventory

   - Continued reviewing collected data.

   - Continued planning fuel pool tilt pit survey.

   - Continued planning fuel pool demineralizer drain down and survey.

4. Future Failure Detection Plan

   - Received the NWT evaluation of procedure RSA-03, "Fuel Performance Monitoring."

   - Continued performing the evaluation of historical radiochemical data using source term spreadsheet.

FUEL RESOLUTION PROJECT
August 6, 1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   - Continue reconstitution of "L" assemblies.
   - Identify and retrieve the piece of material found in the reactor cavity tilt pit.
   - Support debris removal in lower head region of the reactor vessel by shuffling fuel away from access area.

2. UGS

   - UGS lift rig inspection and replacement of corroded carbon steel component.
   - UGS keyway and reactor core barrel key gaging.
   - Additional camera inspection and measurements in support of the root cause evaluation.

3. Fuel Inventory

   - Work with Bechtel fuel recovery specialists to review past actions and plan future activities.
   - Perform spent fuel pool tilt pit survey.
   - Continue planning for the fuel pool demineralizer drain down survey.

4. Future Failure Detection Plan

   - Review NWT evaluation of procedure RSA-03, "Fuel Performance Monitoring."

OUTAGE MILESTONE FORECAST

August 6, 1993

Reconfigure and Reload Reactor Core	08/09/93
UGS Reinstalled	08/22/93
RPV Head Reinstalled-Plant in Cold Shutdown	08/30/93
Equipment Hatch Closed	08/31/93
Leaving Cold Shutdown	09/06/93
Hot shutdown PCS at 525°F and 2000 PSIA	09/06/93
Reactor Critical	09/13/93
Plant on Line Begin Power Ascension	09/16/93

INFORMATION AVAILABILITY SCHEDULE
FOR ROOT CAUSE DETERMINATION AND CORRECTIVE ACTION

August 6, 1993

PRC REVIEW (R) AND/OR APPROVAL (A)		NRC/CPC INFORMATION EXCHANGE TELEPHONE CONFERENCE	ALL INFORMATION FINAL AND AVAILABLE FOR NRC REVIEW
1. FUEL FAILURE Reload Safety Evaluation	08/02 (R) 08/18(A)	08/03/93 N/A	08/18
2. UGS Operability Approval	08/12 (R) 08/12 (A)	08/13	08/19
3. FUEL INVENTORY Operability Safety Evaluation	08/17 (R) 08/17 (A)	08/19	08/23
4. FUEL FAILURE DETECTION	08/17 (R)	08/19	08/23

Activities Planned for the Next 48 Hours
August 7, 1993

1. Fuel Failure

   Reconstitute 3 more L fuel assemblies.

2. UGS

   Gage the UGS keyway.

   Gage the core support barrel key.

3. Fuel Inventory

   Continue reviewing data with Bechtal and planning the fuel pool demineralizer drain and survey.

   Perform the fuel pool tilt pit survey.

   Retrieve the PR-2 remote radiation detector.

4. Future Failure Detection Plan

   No activity reported.

FUEL RESOLUTION PROJECT
August 7, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

Completed reconstitution of two more fuel assemblies (13 complete, 3 more to complete the reconstitution of 16 L assemblies to replace the 16 I assemblies previously in the core).

2. UGS

UGS lift rig leveling stud/bearing maintenance was completed. One leveling stud was changed.

Hardness testing was completed on the leveling studs to determine their tensile strength. A Rockwell hardness of 38 was determined which corresponds to a tensile strength of 170,000 psi.

An engineering analysis was performed to justify UGS lifts in the reactor cavity UGH storage area only.

3. Fuel Inventory

Continued reviewing data with Bechtal, planning the fuel pool tilt pit survey, and planning the fuel pool demineralizer drain and survey.

Attempted to retrieve the PR-2 remote radiation detector from the reactor cavity tilt pit. (The normally used retrieval wire was severed during support activities for the fuel rod shard recovery.)

4. Future Failure Detection Plan

No activity reported.

FUEL RESOLUTION PROJECT

August 8, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   Reconstituted one additional "L" fuel assembly, for a total of 14 completed. Two remain to be done.

2. UGS

   UGS keyway gaging was completed. Results are to be evaluated when core support barrel key gaging is completed.

3. Fuel Inventory

   Continued with data review with Bechtel.

4. Future Failure Detection Plan

   No activity reported.

FUEL RESOLUTION PROJECT
August 8, 1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   Reconstituted remaining two "L" fuel assemblies.

2. UGS

   Gage core support barrel keys, both upper and lower.

3. Fuel Inventory

   Continue data review with Bechtel

   Perform tilt pit surveys when higher priority activities allow.

   Retrieve the PR-2 remote radiation probe.

4. Future Failure Detection Plan

   No planned activities reported.

FUEL RESOLUTION PROJECT
August 9, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   - All 16 "L" assemblies reconstituted.
   - Radiation detector sensor retrieved from the tilt pit.
   - Cladding piece retrieved and put into storage basket (still on reactor cavity side, tied off).

2. UGS

   - Gaging of the reactor core support barrel keys (upper and lower) are in progress.
   - Obtained the results of the Rockwell hardness testing on the UGS lift rig leveling studs and the test coupon results from the material (same lot/heat number) from which the leveling studs were manufactured. Although the two leveling stud material properties vary from the originally specified material, the material strength is acceptable for lifting the UGS.

3. Fuel Inventory

   - Smeared another fuel assembly.
   - Continued working with Bechtel to review past activities.

4. Future Failure Detection Plan

   - Prepared draft summary report of actions taken to determine methodology to detect fuel failure similar to that which occurred in fuel assembly I-24 and the changes we will make to our previous practice.

FUEL RESOLUTION PROJECT
August 9, 1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   - A number of miscellaneous activities will take place before final core reload begins; the SAN-08 upper tie plate will be changed out, the retrieved cladding piece will be transferred to the spent fuel pool, the I-024 upper tie plate gauging, H-38 rod inspection.

2. UGS

   - Additional reactor core support barrel flange measurements.

3. Fuel Inventory

   - Drain and survey the fuel pool demineralizer tank.
   - Survey the spent fuel pool tilt pit.
   - Vacuum under core support plate.

4. Future Failure Detection Plan

   - Will send draft fuel detection summary report to NWT Corporation for review.

FUEL RESOLUTION PROJECT
August 10, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   - The I-024 upper tie plate holes were gauged and found acceptable.
   - The H-038 fuel rod was eddy current examined and the pull force data collected. The fuel rod was found acceptable and spring retention was present in the cell even though it was placed into a cell which had previously contained an oversized stainless steel rod.
   - A seven (7) move shuffle was performed to support vacuuming below the core support plate.
   - The SAN-08 lower tie plate was visually inspected to support UGS root cause analysis.

2. UGS

   - Began gauging the core support barrel (CSB) alignment keys; however, the gauge design resulted in erroneous data. The upper key gauge was modified and a new lower key gauge is being fabricated.

3. Fuel Inventory

   - Vacuumed the reactor cavity tilt pit.
   - Drained and surveyed the spent fuel pool demineralizer (T-50). There was no significant amount of fuel.

4. Future Failure Detection Plan

   - Continued drafting a report summarizing recommendations for further fuel failure detection.

Activities Planned for the Next 48 Hours
August 10, 1993

1. Fuel Failure

   - The SAN-08 upper tie plate replacement will be performed.
   - Fuel assembly C-133 will be visually inspected. C-133 was in core location B-19 during cycle 1 when the core barrel vibration problem existed. This assembly was only burned once, any signs of minor interference with the shroud may still be visible.
   - Final core reload is scheduled to begin 8/12/93 at 2400 hrs.

2. UGS

   - Perform UGS levelness adjustments.
   - Gauge the CSB keys.
   - Take CSB flange measurements.

3. Fuel Inventory

   - Evaluate results (filter - 150R/hr) of vacuuming the reactor cavity tilt pit.
   - Implement portable geli methodology obtained from Bechtel.
   - Vacuum the reactor vessel under the core support plate.

4. Future Failure Detection Plan

   - Receive comments from Westinghouse on our fuel monitoring procedure.
   - Plan to incorporate pertinent comments into the summary report.

FUEL RESOLUTION PROJECT
August 11, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   - The SAN-08 fuel assembly upper tie plate was replaced. Receipt inspection paperwork which must be completed before the assembly can be released for installation will be completed in time to support the fuel reload shuffle which is scheduled to start on 8/12 at 2400 hrs.

2. UGS

   - UGS lift rig levelness measurements were taken. Levelness repeatability was demonstrated. This was attributed to the previous maintenance performance on the lift rig leveling stud bearing and minor adjustments to leveling stud nuts. Additional core barrel flange measurements were taken and will be evaluated today.

3. Fuel Inventory

   - Performed vessel vacuum with no significant fuel recovery.

   - Performed calibrations of portable Lithium/Germanium Detector System and set up Bechtel methodology.

4. Future Failure Detection Plan

   - Continued preparing the draft summary report.

FUEL RESOLUTION PROJECT
August 11, 1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   - Preparations are being made to support reload shuffle.
   - Fuel assembly C-133 will be visually inspected.

2. UGS

   - Reactor core barrel key gauging will commence.

3. Fuel Inventory

   - Continue to work on methodology.
   - Take surveys for fuel recovery.
   - Offsite evaluator will arrive for review and assessment activities.

4. Future Failure Detection Plan

   - Receive Westinghouse comments on our fuel monitoring procedure and incorporate them into the report.

REVISED

OUTAGE MILESTONE FORECAST

August 12, 1993

Reconfigure and Reload Reactor Core	(start 08/13/93)	08/16/93
UGS Reinstalled	(trial installation start 08/17/93)	08/22/93
RPV Head Reinstalled-Plant in Cold Shutdown	(start 08/24/93)	08/30/93
Equipment Hatch Closed		08/31/93
Leaving Cold Shutdown		09/05/93
Hot shutdown PCS at 525°F and 2000 PSIA		09/06/93
Reactor Critical		09/13/93
Plant on Line Begin Power Ascension		09/15/93

FUEL RESOLUTION PROJECT
August 12, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   - C-133 assembly was visually inspected. There was no conclusive evidence that any rubbing against the shroud had occurred.

2. UGS

   - Reactor core support barrel key original tolerance gauging completed. Most notable were the lower keys which gauged 0.030 - 0.045 inches undersized. Undersized keys would allow added unlevelness/tilt of UGS when lifted. Also during lower key gauging, indications were observed on the core support barrel (approximately at the 45° location). The indications were shiny linear marks just above the fuel assemblies and progressing upwards several feet. These indications appear to be wear marks from the UGS riding up the core barrel during UGS lifts/insertions.

3. Fuel Inventory

   - Reviewed data with Consumers Power Company corporate health physicist.

   - Prepared and calibrated portable GELI.

4. Future Failure Detection Plan

   - Drafted the summary report. Received verbal comments from NWT on the draft.

FUEL RESOLUTION PROJECT
August 12, 1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   - The fuel shuffle to support final core reload will begin tonight (8/12) at 2400 hrs.
   - Continue to work preparing our response to the request for additional information and revising our 10CFR50.59 reload evaluation.

2. UGS

   - Review of procedure for UGS insertion is to begin. Procedure objectives are to establish and monitor UGS levelness, monitor location of UGS fuel alignment plate pins with respect to video/lighting system for monitoring UGS lifts/insertions.
   - Conduct conference call with NRC on 08/13/93 at 1330 hrs to discuss UGS root cause evaluation status.

3. Fuel Inventory

   - Perform surveys with portable GELI.

4. Future Failure Detection Plan

   - Begin incorporating Westinghouse comments into the report upon receipt.
   - Plan to discuss the report at the 08/12/93 conference call.

FUEL RESOLUTION PROJECT
DATE 8/13/93

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   - Fuel shuffle began ~0200 this morning and will continue through the weekend.

2. UGS

   - Continue development of UGS insertion procedure.

3. Fuel Inventory

   - Continue surveys with portable GELI.

4. Future Failure Detection Plan

   - Finalizing the report.

FUEL RESOLUTION PROJECT
DATE 8/13/93

Activities Planned for the Next 48 Hours

1. Fuel Failure

   - Fuel shuffle will continue.
   - Request for Additional Information response will be faxed by the end of the day today (8/13) followed by formal transmittal through Licensing on Monday 8/16.

2. UGS

   - Finalize development of UGS insertion procedure (08/17/93)

3. Fuel Inventory

   - Continue surveys with portable GELI.

4. Future Failure Detection Plan

   - Continue finalizing the report.

Potential contributors that are highly likely to solely result in bent fuel alignment pins and/or stuck fuel assemblies:

1 tilted/unlevel UGS
2 UGS with bent fuel alignment pins
3 fuel assembly not properly positioned or seated

Potential contributors that have moderate magnitudes and probabilities and could combine with other contributors to bend fuel alignment pins and/or stick fuel assemblies:

4 fuel assembly bow
5 fuel alignment pins with degraded surface conditions

Discussion

In 1988 or prior an unknown initiating event occurred which bent UGS fuel alignment plate pins (2) or resulted in the UGS fuel alignment plate pins to be misaligned with the fuel assembly upper tie plate holes (1,3,4) such that a fuel assembly (K-028) was extracted (core location Z-11) with the UGS when lifted. It was noted just prior to the lift, the UGS lift rig was examined to insure structural integrity. The lift rig leveling stud nuts were inadverantly backed off to gain access for a nondestructive examination. The leveling studs were attempted to be returned back to their original position. This may have contributed to a UGS lift rig unlevelness (1).

Fuel assembly K-028 was disengaged from the UGS fuel alignment plate by use of a slide hammer (2,5).

Gaging of the UGS fuel alignment plate pins corresponding to the Z-11 core location was attempted unsuccessfully due to tooling difficulties. However it was concluded the pins were acceptable.

1990 Refueling Outage , the UGS was lifted without incident. Fuel assembly H-021 was in core location Z-11. The absence of potential contributors or lack of combination of contributors could account for this. They are tilted/unlevel UGS (1), fuel assembly not properly positioned or seated (3), or fuel assembly bow (4). Current information indicates variations in levelness of the UGS/UGS lift rig with each lift. It is possible a more level lift was accomplished in 1990. Additionally, if fuel assembly H-021 was fully seated or of a lesser bowed configuration, less misalignment of the UGS fuel alignment plate pins and fuel assembly upper tie plate holes may have accounted for H-021 fuel assembly not being lifted with the UGS.

1992 Refueling Outage, fuel assembly I-028 was extracted with the UGS when lifted. Again various contributors may have come into play. In 1990 when the UGS was reinstalled a levelness (1) difference may have occurred. As indicated, it is now known variations in levelness occur with each lift. It is now understood that an unlevelness condition could cause UGS fuel alignment plate pins to enter the fuel assembly upper tie plate and experience lateral loading which could contribute to pin bending. It is also noted that if pin bending was experienced in 1988, the pins in the Z-11 location would no longer be shouldered against the UGS fuel alignment plate. This would reduce the pins stiffness requiring less lateral force to further bend the pins. Also potentially contributing to the I-028 event are fuel assembly not properly positioned or seated (3), fuel assembly bow (4) and fuel assembly alignment pins with degraded surface conditions (5).

I-028 fuel assembly was removed from the UGS when hooks were attached to the fuel assembly upper tie plate and an upward force applied. This may have contributed to further degradation of the Z-11 UGS fuel alignment plate pins surface condition (5).

Gaging of the UGS fuel alignment plate pins at the Z-11 location identified bent pins (2). Straightening the pins was accomplished followed by satisfactory gaging. Though straightening returned the pins to an acceptable straightness, the pins as found in 1993 had a curved profile and a definite gap between the pin shoulder and the UGS fuel alignment plate. Straightening may have contributed to further pin degraded surface condition (5).

1993 Refueling Outage lifted the UGS successfully. Contributions to this could be postulated to be UGS/lift rig being somewhat level, pin straightening in 1992, and proper seating of SAN-08 fuel assembly. However after reinsertion of the UGS, a second lift of the UGS was required to investigate a fuel assembly failed fuel rod. The second lift of the UGS extracted the SAN-08 fuel assembly at core location Z-11. During refueling, SAN-08 had been rotated 180 degrees and put back into Z-11 core location.

The root cause investigation has identified the following;

- UGS fuel alignment plate pins in location Z-11N (1.56 degrees), Z-11S (0.41 degrees) and Z-16S (0.99 degrees) were bent (2).

- A single gage of 0.995" diameter could not be placed on Z-11N and Z-16S indicating the pins to be curved (2,5).

- Analyses indicate that angular misalignment between UGS fuel alignment pins and fuel assembly upper tie plate of 1-1.5 degrees is sufficient to lift fuel assemblies (2).

- Qualification test results and analyses indicate that bent and straightened pins have a gap between alignment pin shoulder and the UGS lower alignment plate. Bent and straightened pins are less rigid and less resistant to bending than originally installed pins (2).;

- SAN-08 upper tie plate has two distinctive peen marks offset toward shroud from center of upper tie plate holes by approximately 0.5 inch. Peen marks are in the orientation and separated by about the spacing of UGS fuel alignment plate pins (3).

- SAN-08 video camera inspection in spent fuel pool identified a piece of debris stuck to the bottom of one foot. Debris could have made it harder to fully seat SAN-08. An object 0.05 inch thick under an assembly foot would dislocate upper tie plate by approximately 0.5" (3).

- With only SAN-08 removed from location Z-11, the core support plate was inspected with no debris identified. Several days later with five assemblies removed from around Z-11 location, debris was observed (3).

- Reactor head alignment pin at 0 degree location was incorrectly installed (1).

- Measurement of UGS levelness on successive lifts indicates significant variation of direction and magnitude of out-of-levelness (1).

- Analysis indicate assembly bow may contribute to angular misalignment between UGS alignment pins and upper tie plate (4).

- Close up video camera inspection of UGS alignment pins at location Z-11 indicated greater degree of contact with upper tie plate alignment holes (5).

- Tip of UGS fuel alignment plate pin at location Z-16S was observed to be distorted during video camera inspection (5).

ACTIONS TO PREVENT REOCCURRENCE

- Replace UGS fuel alignment plate pins Z-11N, Z-11S and Z-16S
- Replace fuel assembly (SAN-08) upper tie plate for core location Z-11. Upper tie plate modified design reduces the potential for interference between tie plate alignment holes and UGS alignment pins
- Implement trial methods to evaluate fuel assembly elevations and relative positions after reactor core reloads
- Modify equipment or revise procedures to assure UGS lift rig/UGS levelness can be established
- Modify procedures to assure UGS is level within acceptable limits prior to lift of UGS
- Close out UGS root cause evaluation and any associated outstanding activities

Potential Contributors Eliminated as Root Cause

- UGS fuel alignment plate pins out of position or core support plate holes are out of position.
- UGS fuel alignment plate pins may be loose or returned to bent state during operation.
- Deformation of core shroud creates an interference between UGS fuel alignment plate pins and the fuel assembly.
- Undersized upper tie plate holes in fuel assembly SAN-08.
- Loss of structural rigidity of UGS.
- Damage to UGS fuel alignment plate.
- Debris between fuel assembly upper tie plate holes and UGS fuel alignment plate pins.
- Mislocation of core support barrel.

POTENTIAL CONTRIBUTOR

UGS fuel alignment plate pins out of position or core support plate holes are out of position.

FINDINGS

Fuels Manufacturer has not changed tolerances or manufacturing tolerances on upper tie plates except for increase of hole diameter from nominal 1.000 to 1.002 inch and tightening of tolerance for hole true position.

Go-No-Go gage verified spacing of UGS fuel alignment plate pins.

Gaging of core support holes at location Z-11 indicated hole diameter to be within manufacturing tolerance.

Fuel assembly SAN-08 was observed to satisfactorily seat in core location Z-11.

Contributor eliminated.

POTENTIAL CONTRIBUTOR

UGS fuel alignment plate pins may be loose or returned to bent state during operation.

FINDINGS

Video camera inspection of locking welds on fuel alignment plate pin nuts showed welds to be sound. One inconsequential crack observed on a nut to lower flange lock weld.

Bent pins were determined to not be loose.

Analysis indicates that loose pin unlikely to contribute to fuel assembly lifting.

Contributor eliminated.

POTENTIAL CONTRIBUTOR

Deformation of core shroud creates an interference between UGS fuel alignment plate pins and the fuel assembly.

FINDINGS

Video camera inspection showed no indication of core shroud rubbing or scraping on side of fuel assembly SAN-8.

Video camera inspection of shroud showed no indication of deformation.

Contributor eliminated.

POTENTIAL CONTRIBUTOR

Undersized upper tie plate holes in fuel assembly SAN-8.

FINDINGS

Upper tie plate holes in fuel assembly SAN-8 were gaged. Proper sized gage (1.000 inch) inserted in upper tie plate hoes.

Contributor eliminated.

POTENTIAL CONTRIBUTOR

Loss of structural rigidity of UGS.

FINDINGS

A video inspection of the condition of fillet welds used to lock nuts to the UGS and fuel alignment plate pins indicated that the welds were intact with no significant cracking noted.

The plane of the UGS lower alignment plate established by elevation measurements is parallel to the plane at the UGS lift points as established by elevation measurements.

Contributor eliminated.

POTENTIAL CONTRIBUTOR

Damage to UGS fuel alignment plate.

FINDINGS

An analysis of elevation measurements of a number of locations on the UGS fuel alignment plate indicated that the points measured lie in a plane within the measurement accuracy.

The plane of the UGS fuel alignment plate established by elevation measurements is parallel to the plane at the UGS lift points as established by elevation measurements.

Contributor eliminated.

POTENTIAL CONTRIBUTOR

Debris between fuel assembly upper tie plate holes and UGS fuel alignment plate pins.

FINDINGS

Video camera inspection of upper tie plates of SAN-8 and a number of other assemblies identified no debris which could have contributed to hangup of fuel assemblies in UGS.

Contributor eliminated.

POTENTIAL CONTRIBUTOR

Mislocation of core support barrel.

FINDINGS

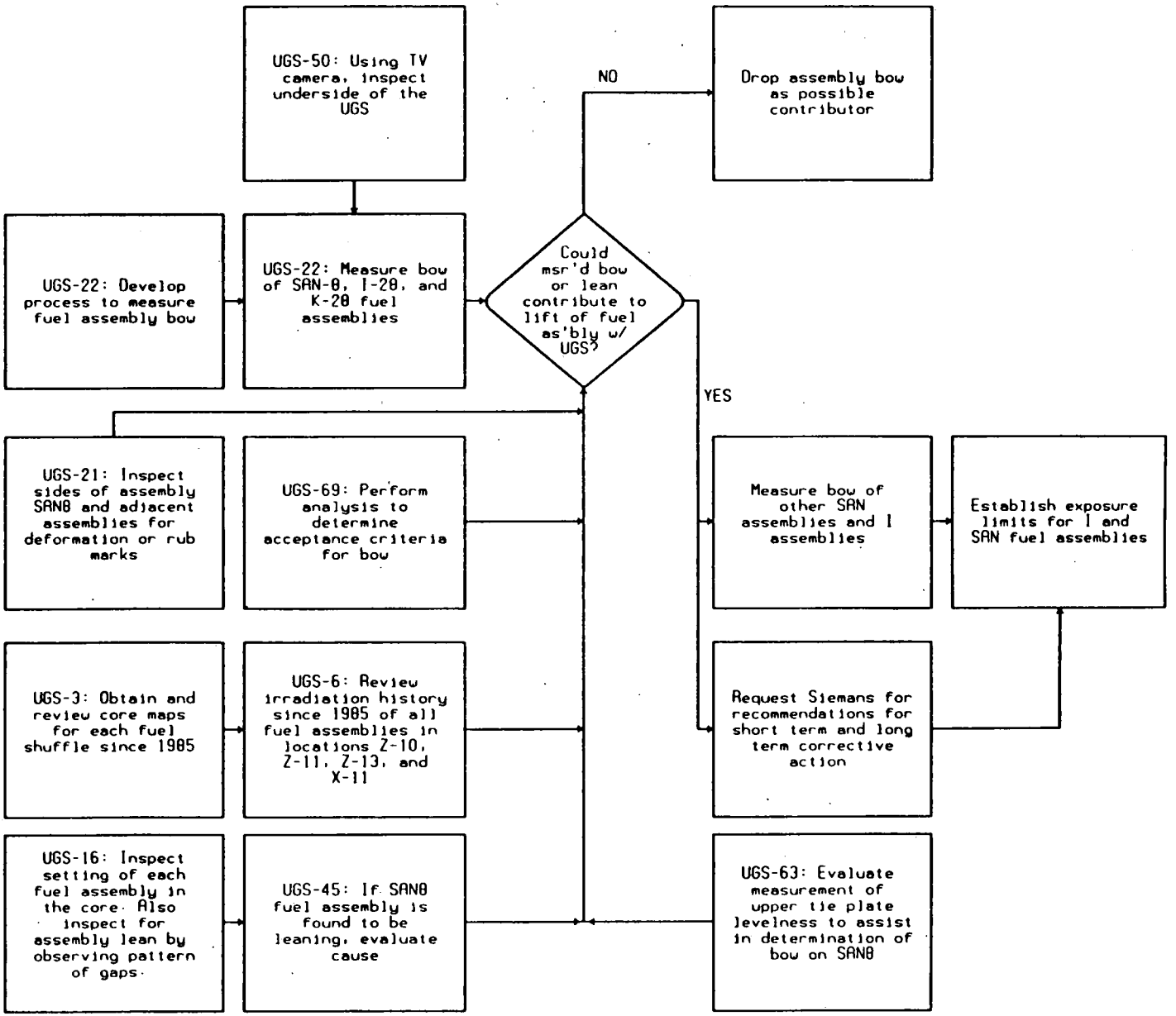
A review of fuel assembly location coordinates and reactor vessel reference locations indicates that no apparent discrepancy exits in core support barrel position.

Contributor eliminated.

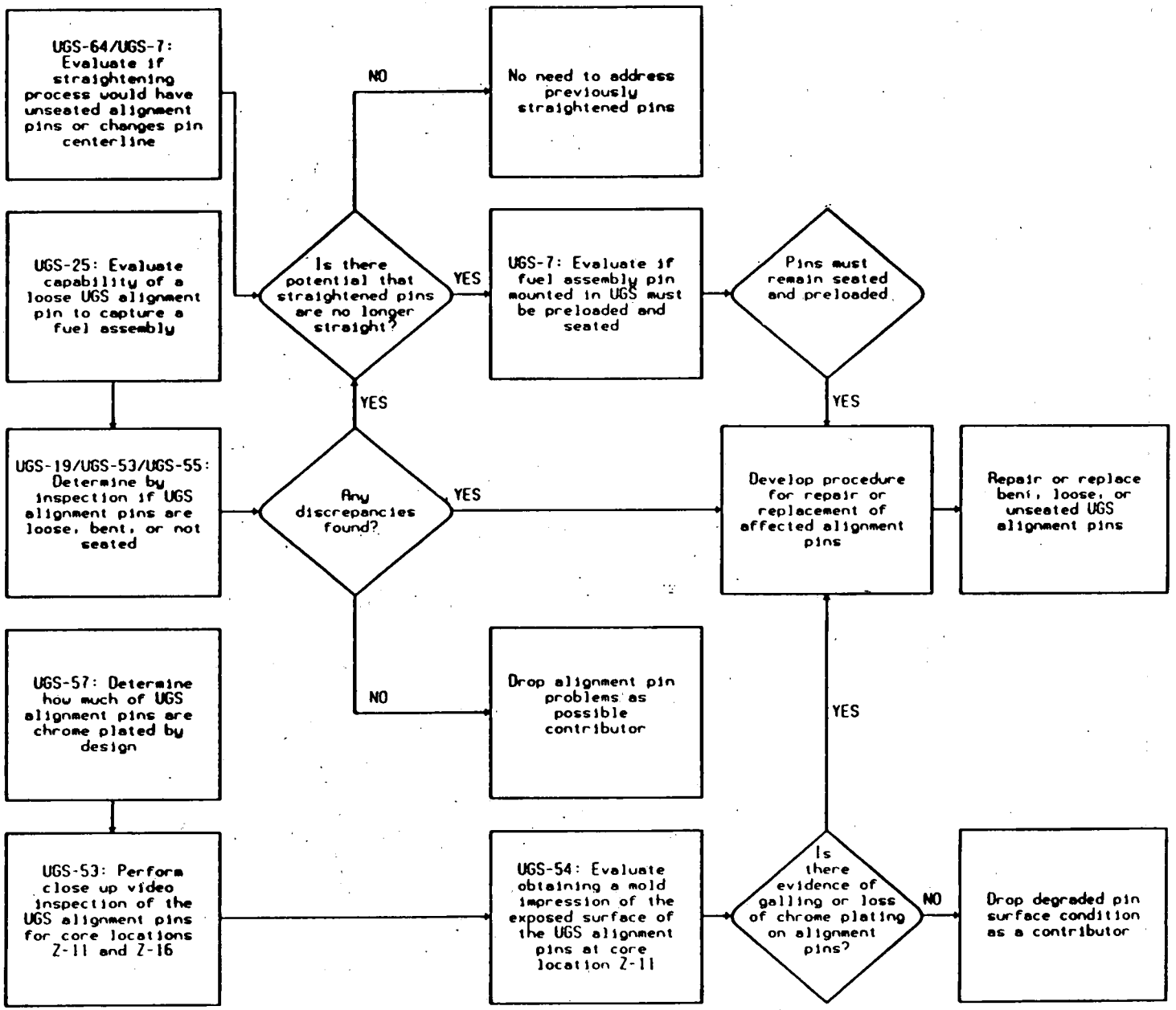
ATTACHMENT 4

SIMPLIFIED LOGIC SCHEMATIC FOR ROOT CAUSE ANALYSIS OF INADVERTENT LIFTING OF ASSEMBLY SAN-8

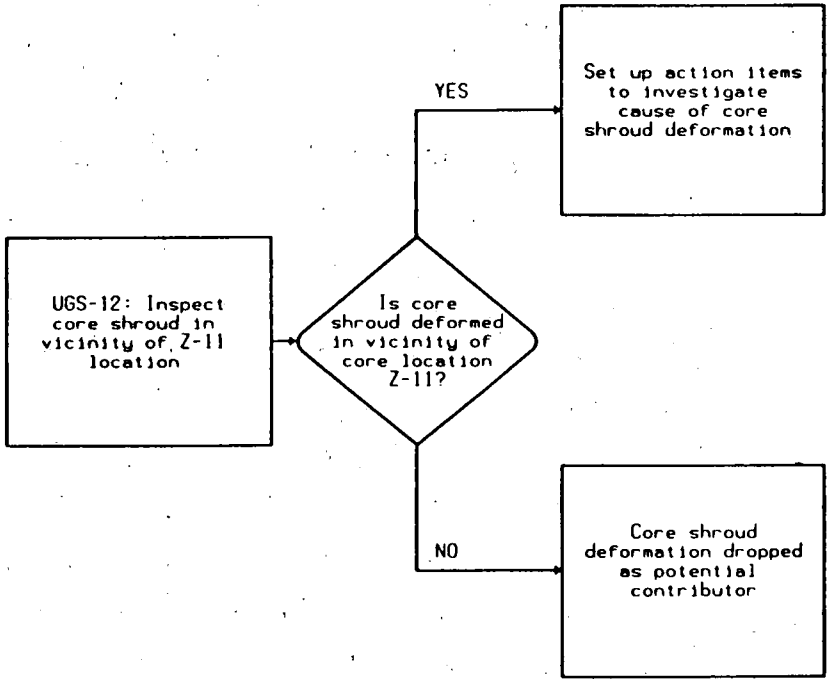
Assembly Bow or Lean



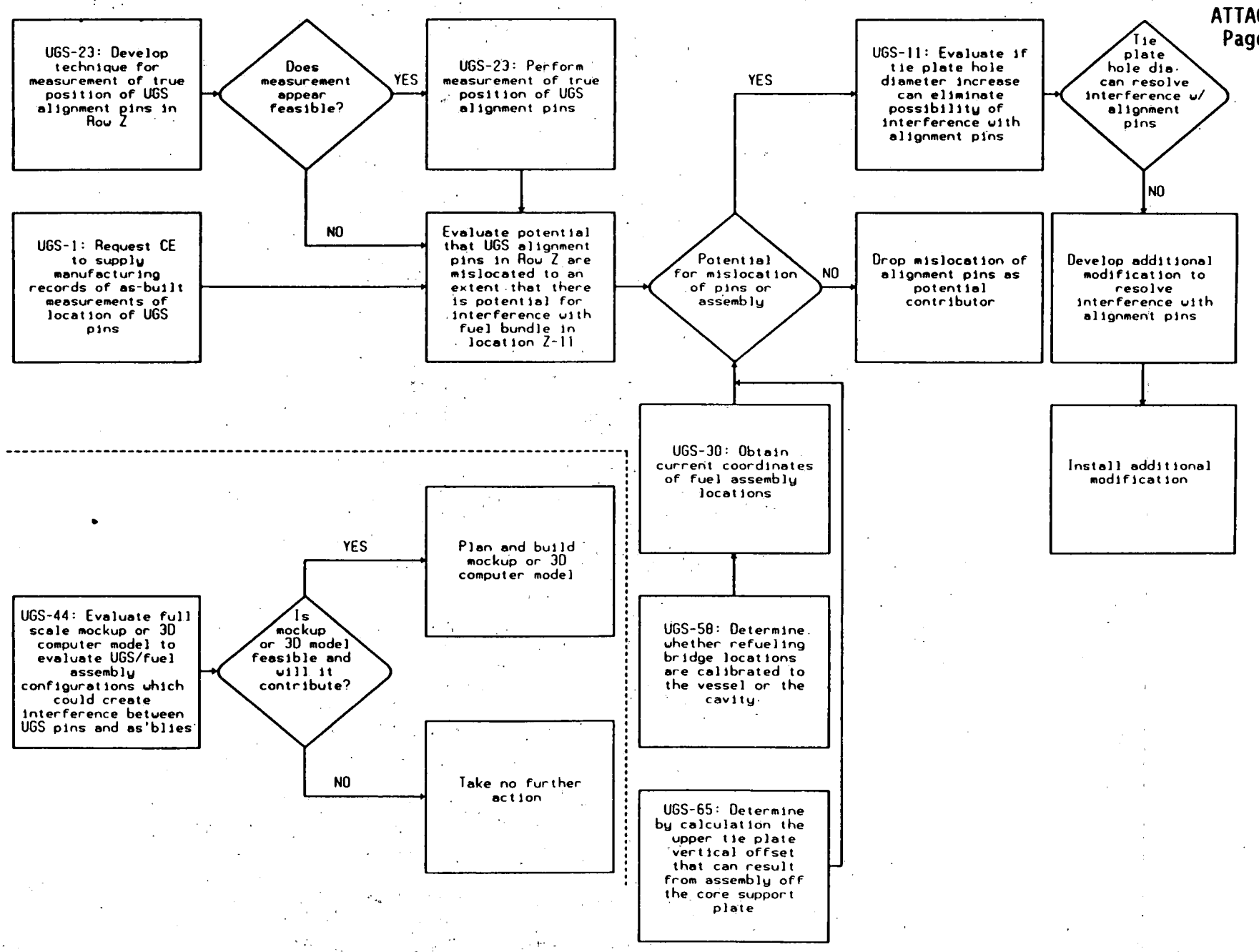
Bent or Unseat[illegible] UGS Alignment Pins

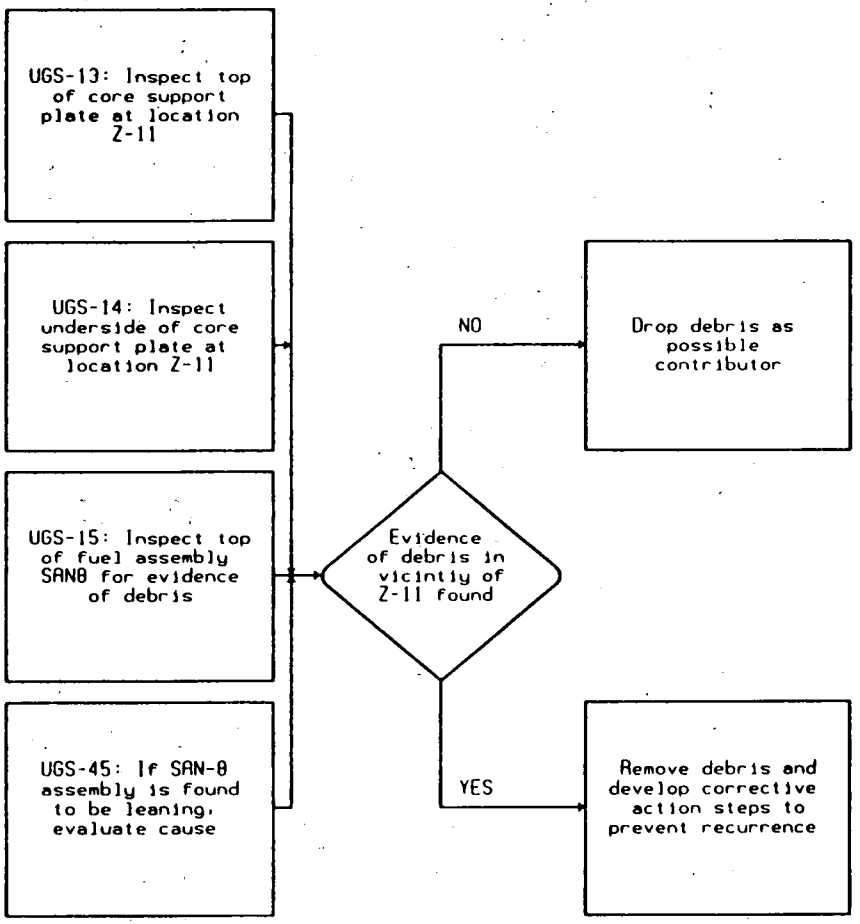


Interference Due to Deformation of Core Shroud

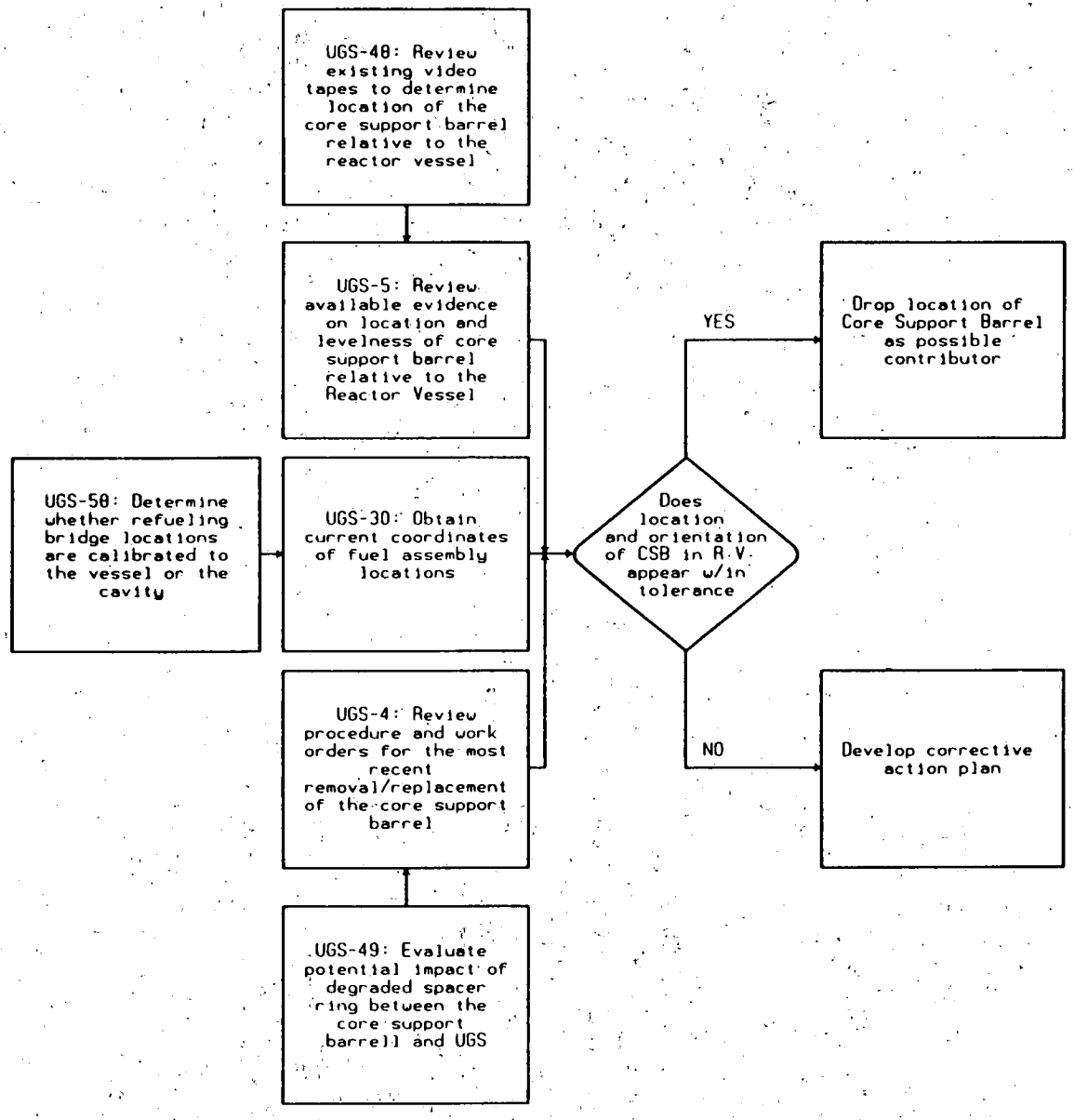


slocation Between UGS Alignment [redacted]s and Fuel Assembly Upper Tie Pl[redacted]e

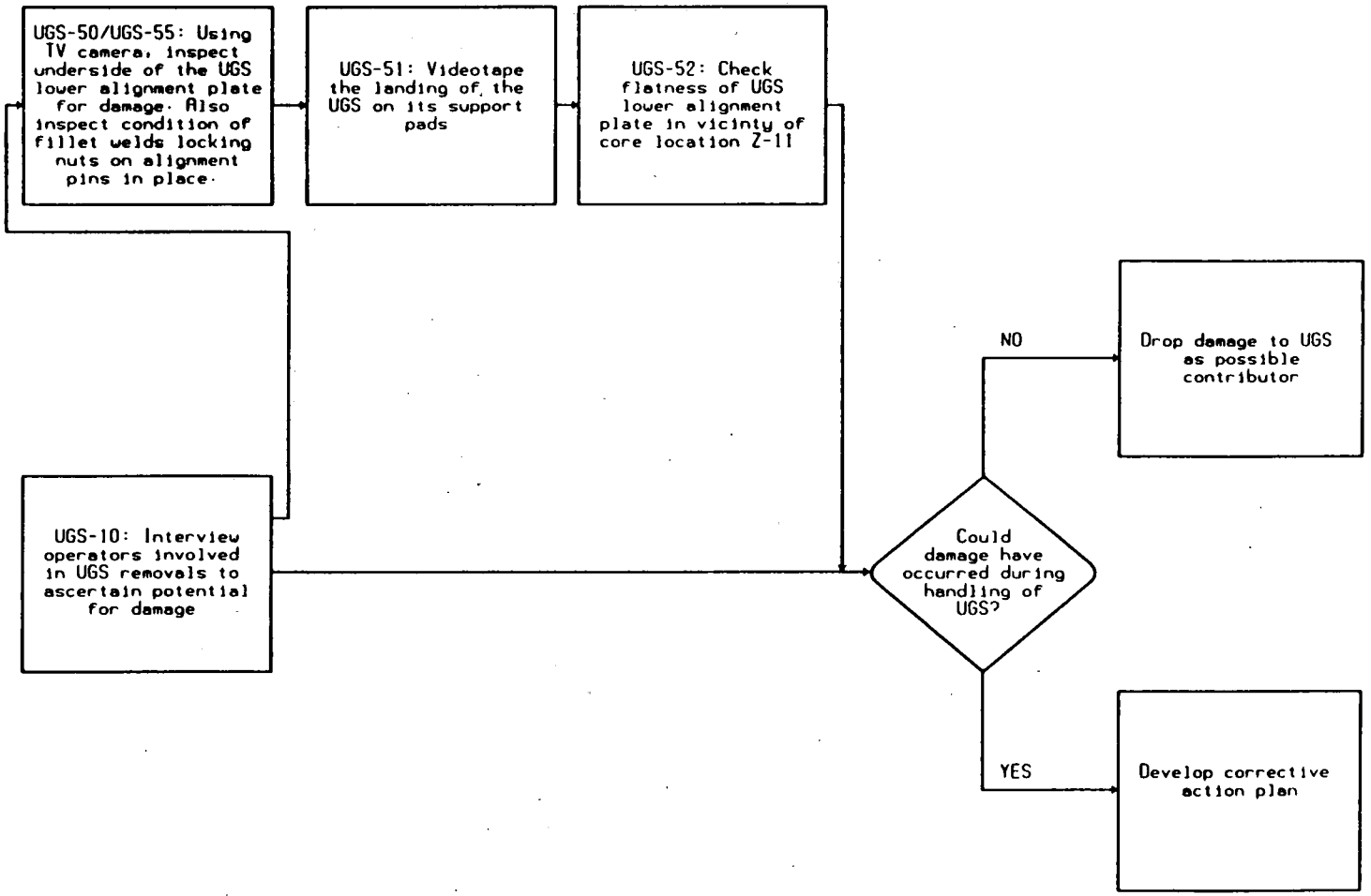



UGS-13: Inspect top of core support plate at location Z-11
UGS-14: Inspect underside of core support plate at location Z-11
UGS-15: Inspect top of fuel assembly SAN8 for evidence of debris
UGS-45: If SAN-8 assembly is found to be leaning, evaluate cause
Evidence of debris in vicintiy of Z-11 found
NO
Drop debris as possible contributor
YES
Remove debris and develop corrective action steps to prevent recurrence

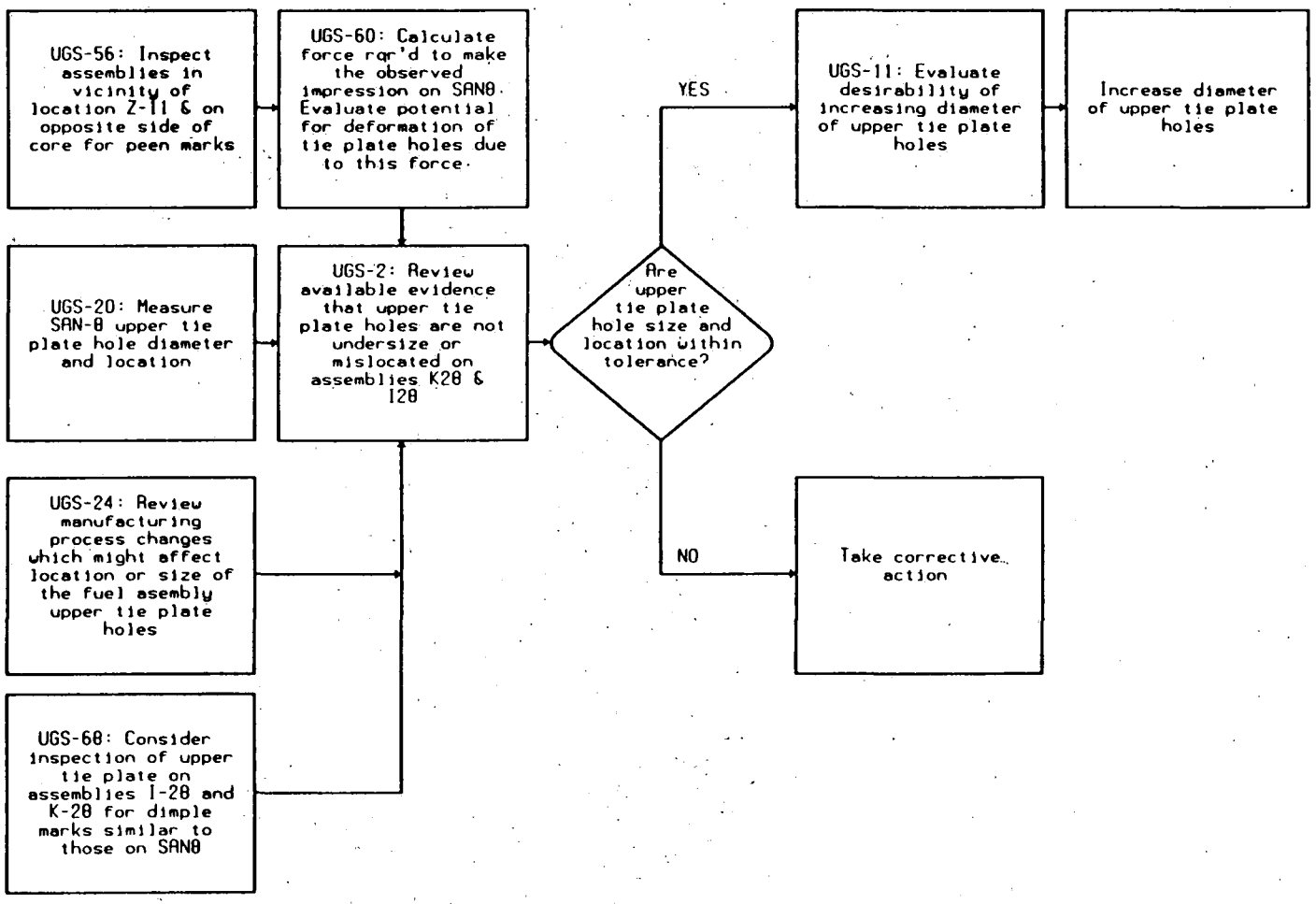
Shift In Location Core Support Barrel



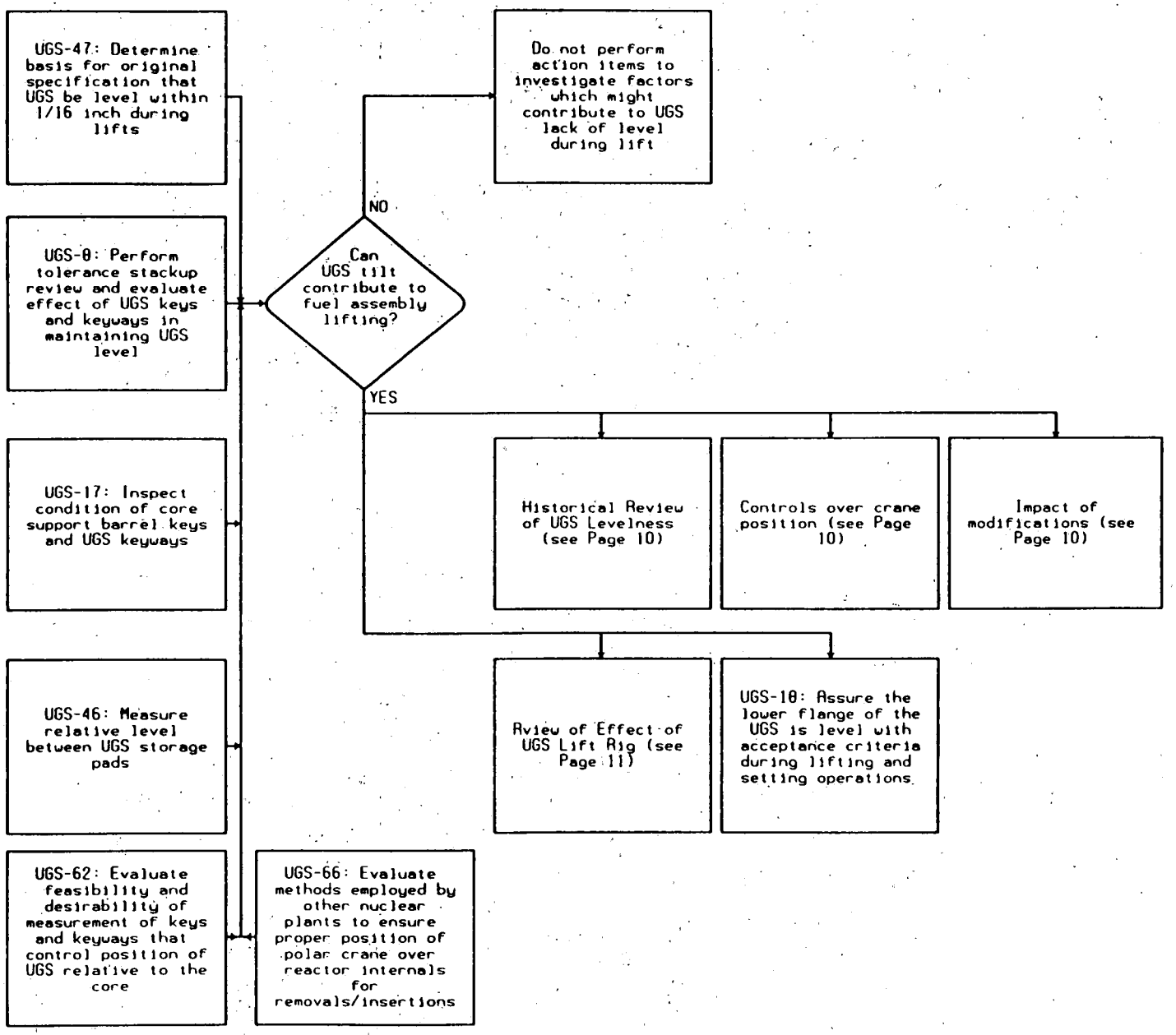
Deformation of UGS



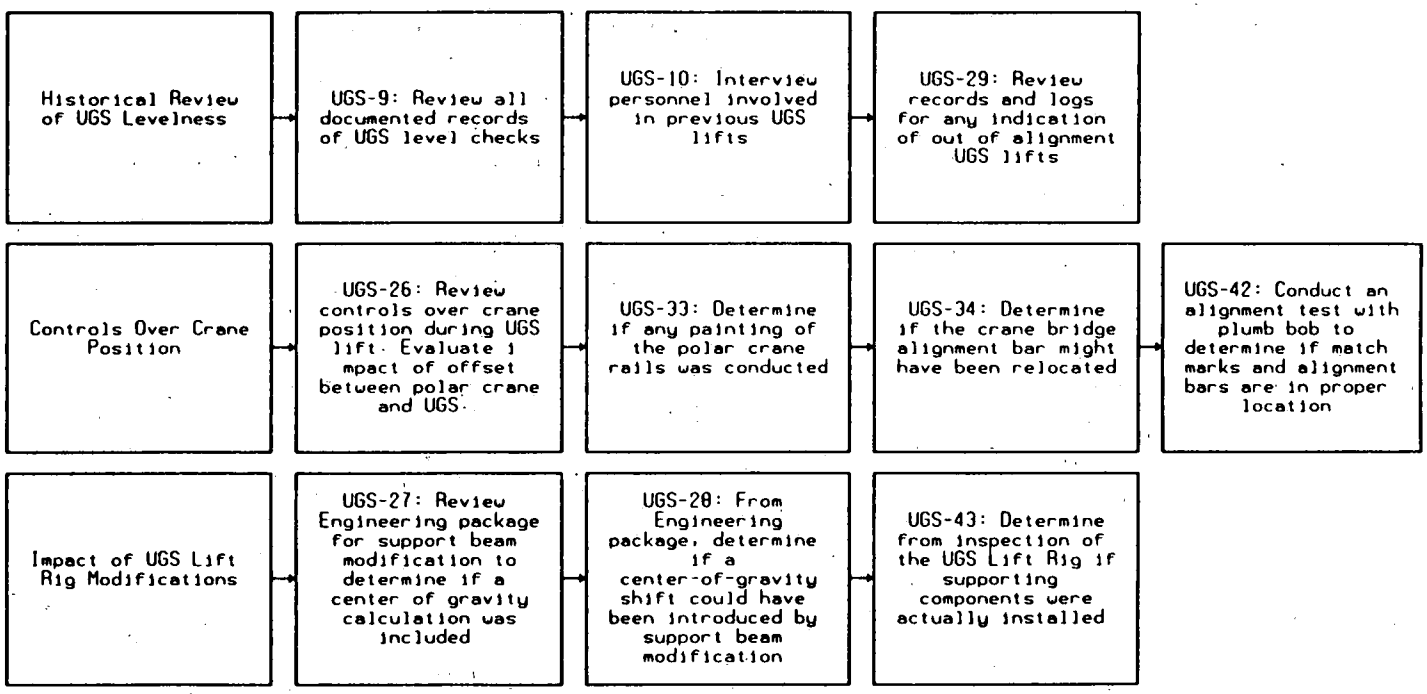
Undersize or Mislocat[illegible] Upper Tie Plate Holes



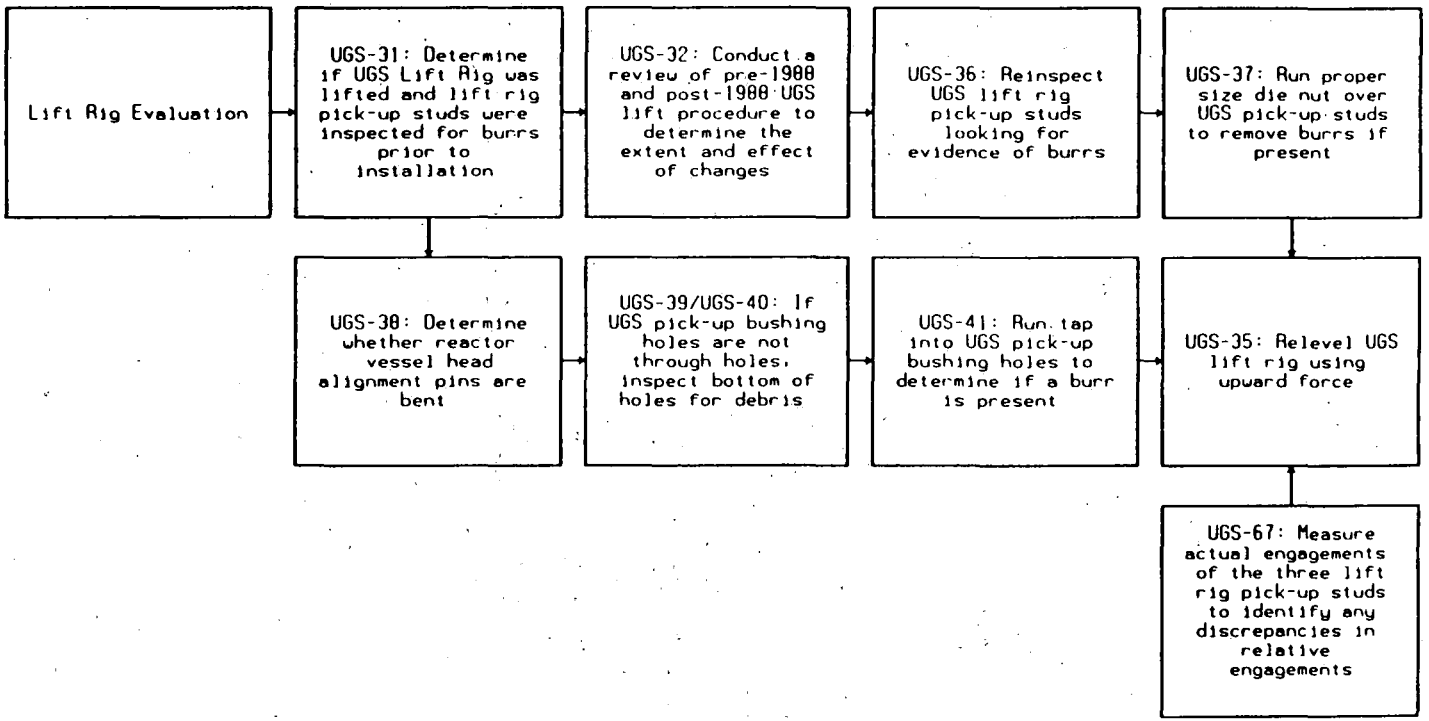
UGS Out of Level During Lifting or Seating



UGS Out of Level During [illegible]ting or Seating (Cont'd)



UGS Out of Level During L[illegible]ing or Seating (Cont'd)



FUEL RESOLUTION PROJECT
August 14, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   Fuel shuffle continues - approximately 2/3 complete at 0900 hrs.

   Conducted visual inspection on remaining 9 I-fuel assemblies. Damage was identified on an I-023 spacer.

2. UGS

   Continued to develop UGS insertion procedure.

3. Fuel Inventory

   No report.

4. Future Failure Detection Plan

   Report summarizing recommendations for further fuel failure detection was completed Thursday.

FUEL RESOLUTION PROJECT
8/14/93

Activities Planned for the Next 48 Hours

1. Fuel Failure

   Complete inspection of shroud area around the I-fuel assembly locations.

   Complete the fuel shuffle.

2. UGS

   Finalize the UGS insertion procedure.

   A Plant Review Committee meeting is planned for Monday 8/16 to review the UGS root cause evaluation.

3. Fuel Inventory

   Collection of both scraping samples and smears from a fuel rod to help determine the deposition of fuel in the core.

4. Future Failure Detection Plan

   No report.

FUEL RESOLUTION PROJECT

August 15, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   Completed move 65 of 92 before the refueling machine became inoperable. Continuing with troubleshooting the refueling machine up-and-down hoist position indication. Core shroud inspection is ongoing.

2. UGS

   Continued to develop UGS insertion procedure.

3. Fuel Inventory

   Obtained a sample from bundle L-45 and reviewing the data.

4. Future Failure Detection Plan

   Report summarizing recommendations for further fuel failure detection was completed Thursday.

FUEL RESOLUTION PROJECT
August 15, 1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   Complete inspection of shroud area around the I-fuel assembly locations.

   Complete the fuel shuffle following refueling machine repair. The estimate for refueling machine repair is Sunday evening (8/15).

2. UGS

   Finalize the UGS insertion procedure.

   A Plant Review Committee meeting is planned for Monday 8/16 to review the UGS root cause evaluation.

3. Fuel Inventory

   Evaluate continued sampling and perform as equipment becomes available.

4. Future Failure Detection Plan

   No report.

PALISADES DISTRIBUTION

GB Slade
DW Rogers
TJ Palmisano
KM Haas
KE Osborne
RJ Gerling
RP Margol
TP Neal
JW McElrath
JL Kuemin
VJ Beilfuss
DL Andersen
RWSinderman, P24-401
RW Smedley (10)
KR Tietema
NRC Resident Inspector (3)

FUEL RESOLUTION PROJECT
August 16, 1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   - Complete the fuel shuffle.
   - Perform the core verification.
   - Submit the docketed response to the 08/03/93 NRC request for additional information and continue preparing the core reload safety evaluation for the 08/19 Plant PRC and NRC review.

2. UGS

   - Finalize the UGS insertion procedure.
   - Plant review committee meeting for UGS root cause (08/16/93).

3. Fuel Inventory

   - Plan spent fuel pool tilt pit survey.
   - Continue to evaluate data.
   - Prepare for the PRC meeting scheduled for tomorrow.

4. Future Failure Detection Plan

   - Present revised failed fuel detection plan at PRC meeting scheduled for tomorrow.

FUEL RESOLUTION PROJECT
August 16, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   - Fuel shuffle resumed ~0100 today after two days of problems with the containment refueling machine. The shuffle is scheduled to be complete by ~2000 hrs today.

   - Remaining I assemblies were visually inspected over the weekend as part of the fuel shuffle. The results are still being evaluated; however, nothing significant was noted on the assemblies.

   - The shroud locations previously adjacent to other I assemblies were videotaped during the weekend. Small debris, including one spacer piece, was retrieved (E-22 location).

2. UGS

   - Review of UGS insertion procedure.

3. Fuel Inventory

   - Continued evaluating data.

4. Future Failure Detection Plan

   - No report.

FUEL RESOLUTION PROJECT
August 17, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   - Continued preparation of the safety evaluation for the reload facility change.
   - Draft proposed corrective actions to prevent recurrence of the I-024 failed rod event were distributed to various parties for review and comment.

2. UGS

   - Continued with UGS insertion procedure development.
   - Plant Review committee meeting conducted for UGS root cause. A decision was made to insert the UGS, and then lift the UGS from the reactor prior to the final UGS set.

3. Fuel Inventory

   - Transmitted survey information (SIRWT) to Bechtel.

4. Future Failure Detection Plan

   - Continued preparing for PRC meeting tomorrow.

FUEL RESOLUTION PROJECT
August 17, 1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   - Finalize reload Facility Change Safety Evaluation for 08/19/93 (0900 hrs) PRC meeting.
   - Continue to work on finalizing proposed corrective action to prevent recurrence.

2. UGS

   - Obtain final approvals of procedure for UGS insertion.
   - Set up for UGS insertion.
   - Begin UGS Insertion.

3. Fuel Inventory

   - Spent fuel pool tilt pit visual inspection
   - Plan for reactor tilt pit flush and vacuum.
   - Present safety evaluation for operation to the PRC for review and approval (8/18/93 at 1000 hrs.)

4. Future Failure Detection Plan

   - Present summary of proposed failed fuel detection methods to PRC.
   - Prepare for NRC information exchange conference call on Friday, 8/20/93

FUEL RESOLUTION PROJECT
August 18, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   - Fuel cladding shard (12 inch piece) was moved into a storage cask and placed in the spent fuel pool.
   - Work continues on the reload safety evaluation/root cause analysis.

2. UGS

   - Continued preparations for the UGS trial insertion (includes procedure review/approvals and tooling fabrication).

3. Fuel Inventory

   - Continued to work on the fuel recovery/operability safety evaluation report.

4. Future Failure Detection Plan

   - Prepared for PRC review of future failed fuel detection methodology.

FUEL RESOLUTION PROJECT
August 18, 1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   - Plant PRC on reload safety evaluation scheduled for 0900 hrs tomorrow.

2. UGS

   - Complete preparations for UGS trial insertion.
   - Begin initial UGS insertion.

3. Fuel Inventory

   - Visual inspection of spent fuel pool tilt pit.
   - Plan the flush and vacuum of the reactor cavity tilt pit.
   - PRC review of the fuel inventory/operability safety evaluation.

4. Future Failure Detection Plan

   - PRC review of future failed fuel detection methodology.

INFORMATION AVAILABILITY SCHEDULE
FOR ROOT CAUSE DETERMINATION AND CORRECTIVE ACTION

August 18, 1993

PRC REVIEW (R) AND/OR APPROVAL (A)		NRC/CPC INFORMATION EXCHANGE TELEPHONE CONFERENCE	ALL INFORMATION FINAL AND AVAILABLE FOR NRC REVIEW
1. FUEL FAILURE Reload Safety Evaluation	08/02 (R) 08/19 (A)	08/03 N/A	08/19
2. UGS Operability Approval	08/16 (R) 08/16 (A)	08/13	08/19
3. FUEL INVENTORY Operability Safety Evaluation	08/17 (R) 08/17 (A)	08/23	08/24
4. FUEL FAILURE DETECTION	08/17 (R)	08/23	08/24
5. SR MANAGEMENT MEETING NRC/CPC PER CAL			WEEK OF 08/30/93

FUEL RESOLUTION PROJECT

August 19, 1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   - Plant PRC on reload safety evaluation scheduled for 0900 hrs today.
   - Visual inspection and retrieval of small suspected cladding piece in the spent fuel pool tilt is planned.

2. UGS

   - Continue level measurements/adjustments
   - Initial UGS insertion.

3. Fuel Inventory

   - Perform the flush and vacuum of the cavity tilt pit.

4. Future Failure Detection Plan

   - Initiate actions in response to PRC suggestions affecting failed fuel detection methodology.

FUEL RESOLUTION PROJECT
August 19, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   - A small piece of suspected cladding was discovered in the spent fuel pool tilt pit.
   - Work continued on the reload safety evaluation/root cause analysis.

2. UGS

   - Completed preparations for UGS insertion.
   - Began initial level measurements.

3. Fuel Inventory

   - Performed visual inspection of Spent fuel pool tilt pit.
   - Continued planning for the reactor cavity tilt pit flush and vacuum.

4. Future Failure Detection Plan

   - PRC reviewed fuel detection methodology.

INFORMATION AVAILABILITY SCHEDULE
FOR ROOT CAUSE DETERMINATION AND CORRECTIVE ACTION

August 19, 1993

PRC REVIEW (R) AND/OR APPROVAL (A)		NRC/CPC INFORMATION EXCHANGE TELEPHONE CONFERENCE	ALL INFORMATION FINAL AND AVAILABLE FOR NRC REVIEW
1. FUEL FAILURE Reload Safety Evaluation	08/02 (R) 08/19 (A)	08/03 N/A	08/19
2. UGS Operability Approval	08/16 (R) 08/16 (A)	08/13	08/19
3. FUEL INVENTORY Operability Safety Evaluation	08/18 (R) 08/23 (A)	08/23	08/24
4. FUEL FAILURE DETECTION	08/23 (R)	08/23	08/24
5. SR MANAGEMENT MEETING NRC/CPC PER CAL -			Tentatively planned for 09/09/93 at 1300 hrs at the Benton Harbor Holiday Inn

FUEL RESOLUTION PROJECT
August 20, 1993

Summary of Activities Performed in the Last 24 Hours

1. Fuel Failure

   - Verified that a piece of cladding was found in the spent fuel pool tilt pit. Video shows that it is a piece of cladding approximately 8-inches long.

2. UGS

   - UGS leveled and moved over the reactor.

3. Fuel Inventory

   - Video taped the inspection of the spent fuel pool tilt pit.
   - Continued planning for the reactor cavity tilt pit flush and vacuum.
   - Received a report from Stoller Corporation on industry experience regarding fuel failure at 12 nuclear plants.

4. Future Failure Detection Plan

   - Continued preparing for plant startup and Monday's NRC conference call.

FUEL RESOLUTION PROJECT
August 20, 1993

Activities Planned for the Next 48 Hours

1. Fuel Failure

   - Continue to support the fuel reload safety evaluation inspection team.

2. UGS

   - Proceed with UGS installation and video inspection set-up.
   - Following acceptable UGS installation, remove UGS.

3. Fuel Inventory

   - Perform the flush and vacuum of the reactor cavity tilt pit.
   - Review tape of spent fuel pool tilt pit reactor survey.

4. Future Failure Detection Plan

   - Continued to revise fuel monitoring procedure.

NOTE: In view of the NRC/CPC concurrence that today's 1600 hrs telephone conference will be the last scheduled daily telephone conference, today's past 24 hour/next 48 hour status report will be the last daily report of this type.

OUTAGE MILESTONE FORECAST

August 20, 1993

UGS Reinstalled	(trial installation started 08/18/93)	08/24/93
RPV Head Reinstalled-Plant in Cold Shutdown	(start 08/26/93)	09/01/93
Equipment Hatch Closed		09/01/93
Leaving Cold Shutdown		09/07/93
Hot shutdown PCS at 525°F and 2000 PSIA		09/08/93
Reactor Critical		09/15/93
Plant on Line Begin Power Ascension		09/17/93