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SUBJECT: Forwards info requested on 960401 re 960401 proposed amend to TS Section 3/4.9.6, "Refueling Machine."

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ENGINEERING

102-03643-JAB/SAB/GAM
April 3, 1996

U. S. Nuclear Regulatory Commission
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Reference: Letter 102-03642, dated April 1, 1996, Proposed Amendment to Technical Specification (TS) Section 3/4.9.6, "Refueling Machine," Under Emergency Circumstances, from W. L. Stewart, Executive Vice President - Nuclear, APS, to USNRC

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Unit 2
Docket No. STN 50-529
Supplement to Proposed Amendment to
Technical Specification (TS) Section 3/4.9.6,
"Refueling Machine," Under Emergency Circumstances

In the referenced letter, Arizona Public Service Company (APS) submitted a proposed Technical Specification (TS) amendment to revise PVNGS Unit 2 TS 3/4.9.6 to temporarily allow the use of a manual hoist instead of the refueling machine for the movement of the fuel assembly at core location A-07. On April 1, 1996, the NRC Staff requested additional information related to their review of the proposed amendment. The requested information is enclosed.

Should you have any questions, please contact Scott A. Bauer at (602) 393-5978.

Sincerely,

JABailey

JAB/SAB/GAM/rv
Enclosure

cc: L. J. Callan (All w/Enclosure)
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ENCLOSURE

NRC QUESTIONS AND APS RESPONSES RELATED TO PROPOSED AMENDMENT TO TECHNICAL SPECIFICATION SECTION 3/4.9.6 "REFUELING MACHINE" UNDER EMERGENCY CIRCUMSTANCES

NRC QUESTIONS AND APS RESPONSES RELATED TO PROPOSED AMENDMENT TO TECHNICAL SPECIFICATION (TS) SECTION 3/4.9.6 "REFUELING MACHINE" UNDER EMERGENCY CIRCUMSTANCES

1. How will the structural integrity of the fuel assembly at location A-07 be assured during movement?

Response:

Structural integrity of the fuel assembly will be assured by installing external reinforcement using one of the following two methods:

The first method of reinforcement is the use of two separate 1 inch wide stainless steel straps installed on opposite sides of the assembly. The straps will be attached by clips to a steel jacking plate, installed on the upper plate at the top of the assembly, and to the web of the assembly's lower end fitting (LEF) (See Figure 1). The jacking plate will have adjusting bolts that would press against another steel plate underneath (the bearing plate) and thus pull up on, and tension, the straps. The straps will be tensioned enough to take up the slack, but not enough to compress the fuel assembly.

The second method of reinforcement is the use of stainless steel cables. This reinforcement will consist of separate stainless steel cables (See Figure 2). The ends of the cables will be attached to a steel plate installed at the top of the assembly. This steel plate (the jacking plate) will have adjusting screws that will push against another steel plate underneath (the bearing plate) and thus pull up on, and tension, the cables. The cables will be tensioned enough to take up the slack, but not enough to compress the fuel assembly.

Either the straps or cables are designed for the full weight of the assembly, including all attachments. After the installation of one of the reinforcement mechanisms described above, the EDM cuts on the LEF will be made and, if necessary, the fuel assembly hydraulic jacks will be installed. The hydraulic jacks will provide the lifting force to free the assembly while maintaining a constant load through the fuel handling tool. This method will ensure a smooth lift eliminating sudden movement normally associated with members under tension that are suddenly released.

The Electro-Discharge Machining (EDM) tooling is a process which vaporizes the metal using an electrical arc and will be used to stress relieve the LEF legs. The EDM process will be performed by Combustion Engineering (ABB-CE) with APS support prior to lifting the fuel assembly. To ensure the process is properly controlled, several process control steps have been built into the procedure. The process setup and cutting operation will be monitored by video cameras. During set-up of the EDM cutting head, an end plate will be behind the LEF web and in front of any protruding fuel rods. This will provide EDM protection for the exposed fuel pins for the lower 50 percent of the cut. No misalignment of the cutting head setup will be allowed, and power to the cutting head will only be initiated once the EDM head is verified to be in the correct position to initiate cutting.

ABB-CE has performed calculations showing that the allowable jacking load on the v-notch with a single web cut per side is 3500 pounds. The cuts are planned to be made on the south face of the southwest foot and the north face of the northwest foot. ABB-CE has analyzed the existing crack in the LEF and determined that there is no possibility of "flap" motion as a result of jacking up to 3500 pounds and/or EDM cutting. The basis for this assessment is as follows:

- The majority of the observed deformation is due to plastic rather than elastic deformation. Therefore, spring-back is not expected to be large when the legs and webs, are jacked or altered slightly.

- Following EDM cutting, the LEF legs are still engaged, but with stress relieved. Therefore, the LEF is not expected to move more than a few mils (as a result of the cutting) before the legs would tend to stop any lateral motion.

- The load bearing path from the shroud to front legs/pins occurs primarily through peripheral intact regions of the flow plate. Thus, any load change will not cause a significant change in the stress state at the center region nor any significant change in nozzle/flap rotation.

The core reloading procedure has been modified to ensure the jacking force and hoist load limits are not exceeded.

To improve lateral stability, guide tube stabilizers (304 stainless steel rods) will be installed into two of the guide tubes prior to attempting to lift the assembly. The addition of these stabilizers has no deleterious effect on the assembly and can be reversed at any time later in the handling or storage process.

A center post handling tool will be used to install a center post into the upper end fitting of the fuel assembly. The center post will provide a continuous load path for lifting the fuel assembly, instead of relying on the load path through the guide tubes.

The external reinforcement has been designed and will be tested to support 1600 pounds. The stainless steel reinforcement straps will be load tested to 150 percent of design load (i.e., 2400 pounds). The stainless steel cables have been load tested to show that two strands of the cable (one cable loop) can achieve a 2800 pound force without distortion or breaking.

2. Describe how the temporary hoist will be attached to the refueling machine.

Response:

The temporary lift rig will consist of the following:

- An 8 foot, 4 inch long, 4 inch square steel tube will run across the top of the refueling bridge hoist frame rails. The tube will be attached to the hoist frame rails by two 1/2 inch U-bolts and a 3/4 inch steel plate at each rail. The beam will extend 41 inches

past one side of the refueling machine frame rail. A lug will be welded to the underside of the beam such that the load cell/hoist assembly will hang at a position 36 inches past the frame rail. The beam has a design capacity of at least 3000 pounds, which is approximately 1.5 times the maximum expected load.

- A load cell (with a capacity of 5000 pounds) will be hung from the lug, welded to the underside of the beam at the end, extending past the refueling machine.

- A hoist will be hung from the load cell.

- The new-fuel grapple hung from the hoist.

A drawing is attached that shows the temporary lift rig attachment (See Figure 3).

3. Describe the accuracy of the load cell.

Response:

The load cell is 5000 pound capacity with an accuracy of ± 0.3% full scale or ± 15 pounds.

4. Describe how this temporary lift rig assembly will be load tested.

Response:

The APS fabricated components (beam, lug, and attachment of beam to load frame) will be load tested after it is installed on the refueling machine and prior to lifting the fuel assembly. The test will be performed by applying a lift strain, using an attachment point in containment, until the 3000 pound load test force is reached. The load test will verify the strength of the APS fabricated components. The load test will not include the hoist, load cell, and new-fuel grapple. The other rigging components (excluding the APS fabricated components) have been certified by the manufacturer, or load tested and certified in accordance with the PVNGS rigging control program to have capacities in excess of any expected loads during the evolution. All of the components will be assembled in accordance with the drawings by personnel certified in accordance with the PVNGS rigging control program.

5. Describe how the temporary hoist will be attached to the fuel assembly.

Response:

The new-fuel grapple will be used to connect the temporary hoist to the fuel assembly. The new-fuel grapple engages the assembly in the same manner as the refueling machine grapple. This grapple is similar to the grapple on the refueling machine, except that the new-fuel grapple also has a locking collar that provides a positive hold on the hooks latched to the fuel assembly. The new-fuel grapple is normally used to move new-fuel

from the shipping container to the new-fuel storage racks and from the new-fuel storage racks to the spent fuel pool.

6. **Discuss single failure protection (current refueling machine vs alternate lift rig).**

Response:

The current refueling machine was not designed or licensed to be single failure proof. Similarly, the temporary lift rig is not designed to be single failure proof.

7. **Discuss the load path of the fuel assembly including any intermediate steps to storage.**

Response:

The fuel assembly will initially be lifted a sufficient distance to clear the fuel alignment pins. Once the assembly has cleared the alignment pins, it will be moved to position it over the fuel cap fixture, which will have been placed as close as possible to the A-07 location. The fuel cap fixture restricts further movement of the fuel rods. The fuel assembly will be slowly lowered on to the fuel cap fixture until it engages the LEF. When the integrity of the fixture has been verified to be secure, the assembly will again be lifted and bridged west to the reactor center-line. From this location, the load path will be the same as that followed during normal refueling operations. The load path is due south to the trolley index zone, and then west to the upender. The upender takes the fuel assembly through the transfer canal to the spent fuel pool area. The spent fuel bridge will then transfer the assembly to location A-38.

The April 1, 1996, submittal requesting the TS amendment stated that the bridge and trolley speeds would be restricted to the minimum speeds available. It is intended that the speeds will be selected to minimize fuel assembly swing and to ensure positive control of the fuel assembly is maintained at all times.

8. **Describe the refueling water clarity and the contingency should clarity be diminished.**

Response:

The water clarity in the refueling cavity and reactor vessel is maintained in a near transparent state, free from pollution and cloudiness, by the fuel pool cooling and cleanup system (PC) and submersible filtering units.

The PC system utilizes a disposable resin mixed bed ion exchanger that is capable of 150 gallon per minute flow through three micron filters. The system will maintain radiological exposure in the vicinity of the pool to <2.5 mRem/hr and also maintains water clarity through the removal of particulates and dissolved solids.

The PC system has been augmented by two submersible filtering units which are installed in the refueling pool. These filtering units are capable of 650 and 250 gallon per minute flow rates through 1 micron filter. The 250 gpm unit has a skimmer attachment; and both units are in continuous operation. Plant experience has demonstrated that 500 gpm flow is sufficient to maintain water clarity and that filter plugging is unlikely because of the small particulate size.

Water clarity will be maintained such that refueling personnel will be able to clearly view the fuel and refueling tools both from underwater cameras and from above. Underwater lights have been installed to enhance viewing capability. If the water clarity should diminish such that viewing is impaired, fuel movement will be suspended until clarity is restored.

9. **Discuss how the assembly will be kept stable during the jacking and lifting and also during lateral transit. Include a discussion about the jacking method and any analysis of the possibility of a sudden jump while jacking.**

Response:

The structural integrity of the fuel assembly will be reestablished using either of the techniques discussed in response to Question 1. These techniques will provide the mechanism to augment/replace the guide tubes as the main structural lifting members. Guide tube stabilizers will be installed into two of the guide tubes to provide additional lateral stability.

Upon installation of the external reinforcement, the fuel assembly will be grappled using hoisting equipment as described in response to Question 2. A manual hoist will be attached to a fuel handling tool which utilizes a fuel assembly grapple, locking device, and rigging attachment. Once the assembly has been grappled, lifting force will be applied with the hoist. This lifting force will provide stability of the fuel assembly during the jacking evolution.

Two fuel assembly hydraulic jacks will be utilized. One will be positioned on the north face and the other on the south face at the web area of the foot of the assembly. The EDM cuts on the LEF legs are expected to relieve much of the frictional force between the legs and the alignment pins. The two west side alignment pins are taller than the east side alignment pins. The total height of the west side tapered pins is 3.375 inches with a straight shank of 1.75 inches and the balance of the alignment pin length (1.625 inches) tapering down at a 30° slope. Some of the load in the LEF is due to elastic deformation while the majority is plastic deformation. The hydraulic jacks will be in contact with the straps. While maintaining a constant lifting load, an initial pressure will be applied to both hydraulic jacks. Pressure will be increased to a maximum of 3500 psig in 100 psig increments. The intent of this evolution is to provide lift control of the fuel assembly utilizing the hydraulic lifting assemblies.

ABB-CE has performed testing and analyses to evaluate the dynamic movement of the fuel bundle as it is being removed by the hydraulic jacks. Sudden movement of the fuel

assembly as it comes off the alignment pins is expected to be minimal (on the order of mils) and lateral motion of the bundle would be limited by the two taller west alignment pins.

Since the majority of the observed deformation is due to plastic rather than elastic deformation, spring-back is not expected to be large when the "supports," in the form of legs and webs, are jacked or altered slightly. As the bundle is raised above the straight shank, the LEF will attempt to release some of its potential energy. It is at this point when any "jump" would be expected to occur. The EDM cuts on the LEF legs are expected to relieve much of the frictional force between the legs and the alignment pins, minimizing any "jump" which may occur. The legs of the LEF will not lose contact with the two west alignment pins and the potential energy will be dissipated by friction between the leg and the alignment pins as well as between the LEF and the shroud wall. No significant "jumping" of the LEF as it was removed from the alignment pins has been observed during testing.

There is no stored potential energy in the incompressible hydraulic system. The hydraulic jack lifting force will quickly dissipate as the bundle tends to move up just a short distance, since the incompressible hydraulic fluid pressure will decrease almost instantaneously.

During lateral transit, a tag line will be utilized to restrain movement of the fuel assembly and slow speeds will be used as the bridge and trolley are moved.

10. Describe contingency plans if any fuel pins move in the assembly while the assembly is being moved.

Response:

It is not anticipated that fuel pin movement will occur during the evolution of fuel movement. Fuel pin movement has not been observed during past attempts to remove the fuel assembly. The potential for fuel rod movement exists while the fuel assembly is being jacked from its stuck position. During this time a stainless steel plate will be located underneath the stuck assembly in location A-07 to prevent fuel rods falling to the bottom of the reactor vessel. Additionally, a video camera will be monitoring the evolution to ensure that fuel rod movement is detected should it occur.

If fuel rod movement should occur at any time prior to installation of the fuel cap fixture, fuel movement will be immediately stopped.

11. Discuss the operator license qualification and applicability to movement of the fuel assembly using the temporary hoist.

Response:

The Licensed Senior Reactor Operators for refueling (LSRO) training program has been developed in accordance with the INPO accredited training program (ACAD 91-012), "Guidelines for Training and Qualification of Licensed Operators." The LSRO training is a subset of the SRO/RO training program utilizing a systematic approach to training which is implemented through PVNGS training department procedures. The objective of the program is to provide the LSRO candidate or incumbent with the knowledge and skills necessary to perform the duties of a Senior Reactor Operator supervising core alterations. The LSRO tasks are identified in the Job Task Analysis Task-to Training Matrix. The task analysis augments the specific job/ topic analysis and knowledge and abilities identified in NUREG-1122, "Knowledge and Abilities Catalog for Nuclear Power Plant Operator: Pressurized Water Reactor."

The LSRO program consists of initial and continuing training with initial and requalification license examinations administered in accordance with NUREG-1021, "Operator Licensing Examiner Standard (ES 701)." The initial training consists of eight weeks of classroom and four weeks on-the-job training. Continuing training consists of 40 hours prior to each refueling or every six months, whichever is more limiting. Participation in concurrent refueling outages is credited as one refueling and additional training on lessons learned from the previous core offload is provided prior to the second core offload. LSROs are also required to stand a minimum of eight hours in the control room discussing refueling operations, TS associated with refueling, and refueling procedure requirements. Continuing evaluation of the LSRO incumbent's knowledge and abilities is performed through annual operating and biennial written examinations.

PVNGS currently has thirteen LSROs. All thirteen LSROs are current in their qualification status and have an active LSRO license. The LSROs participating in the removal of fuel assembly A-07 will be required to demonstrate satisfactory performance during a "dry run" test using a dummy fuel assembly. This validation test will require the LSRO to perform the revised procedure requirements identified in the core reloading procedure 72IC-9RX03. The procedure has been revised to include precautions and limitations for using the manual hoist. In addition to the procedure requirements, a pre-job briefing will be held with the LSROs, refueling, and control room personnel, to ensure appropriate communications are established.

12. Describe the "procedural controls" that will be used.

Response:

Procedural controls will be implemented to direct the fuel assembly movement evolution. The controlling core reloading procedure will include specific instructions for performing the fuel movement. Prior to implementation, the procedural controls and manual hoist operation will be reviewed with the operators and the procedure will be validated utilizing a dummy fuel assembly. The validation will demonstrate the lifting of the dummy fuel assembly from the core, traversing to the upender, and ungrappling the dummy fuel assembly.

Specific instructions, explanatory notes, and cautionary statements will be provided in the procedure to ensure that fuel movement is halted in the event of any unusual conditions such as unexpected radiological changes, inadequate water clarity, movement

of protruding fuel pins, and/or unanticipated changes in load conditions. These requirements will not preclude placing the assembly in a safe condition.

Instructions will also be provided to compensate for the absence of interlock features of the refueling machine as described in the TS amendment request. These compensatory actions include (but are not limited to) ensuring that: (1) the hoist does not exceed load limits or lifting height, (2) the bridge or trolley will not be moved during the hoisting operation, (3) the hoist shall not be lowered to a no-load (cable slack) condition, and (4) the fuel assembly does not contact any unintended components during hoisting or movement.

13. With respect to the discussion about minimum water coverage over the fuel assembly, clarify the "additional shielding of the handling tool."

Response:

CESSAR Section 9.1.4.3.4.d describes, as a design basis, that nine feet of water above the active portion of a fuel assembly is expected to limit the dose rates at the water surface to 2.5 mRem/hr or less when the additional shielding of the handling tool is taken into account. As stated in the April 1, 1996, amendment request, the manual hoist would be physically limited from raising the fuel assembly above a depth needed to maintain a minimum of nine feet of water above the active portion of the fuel. Although the raised fuel assembly would be outside of the refueling mast, and the normal shielding provided by the refueling machine would be reduced, that shielding is negligible compared with the shielding provided by the nine feet of water.

On March 31, 1996, actual dose rates were obtained for fuel assembly A-07 and documented under Radiation Protection survey 2-96-01672. Based on the results of this survey, dose rate calculations were performed for seven, eight, and nine feet of water. The results of the calculations are as follows:

7 feet = 4.7 mR/hr
8 feet = 0.36 mR/hr
9 feet = 0.0277 mR/hr

Based on these calculations the dose to personnel at the refueling bridge would not exceed the established limits of 2.5 mR/hr even without the additional shielding provided by the refueling mast.

The radiation dose rates will be monitored by portable instruments and personnel doses will be maintained within administrative limits and 10 CFR 20 limits, and will be kept as low as reasonably achievable (ALARA), as required by 10 CFR 20.1101(b) and plant procedures.

14. **Clarify the purpose and functions of the "spotter."**

Response:

The purpose of the spotter is to compensate for the absence of the anti-collision interlock feature of the refueling machine. Each of the refueling team members will act as spotters during fuel movement, although one of the refueling operators will be specifically tasked as a spotter.

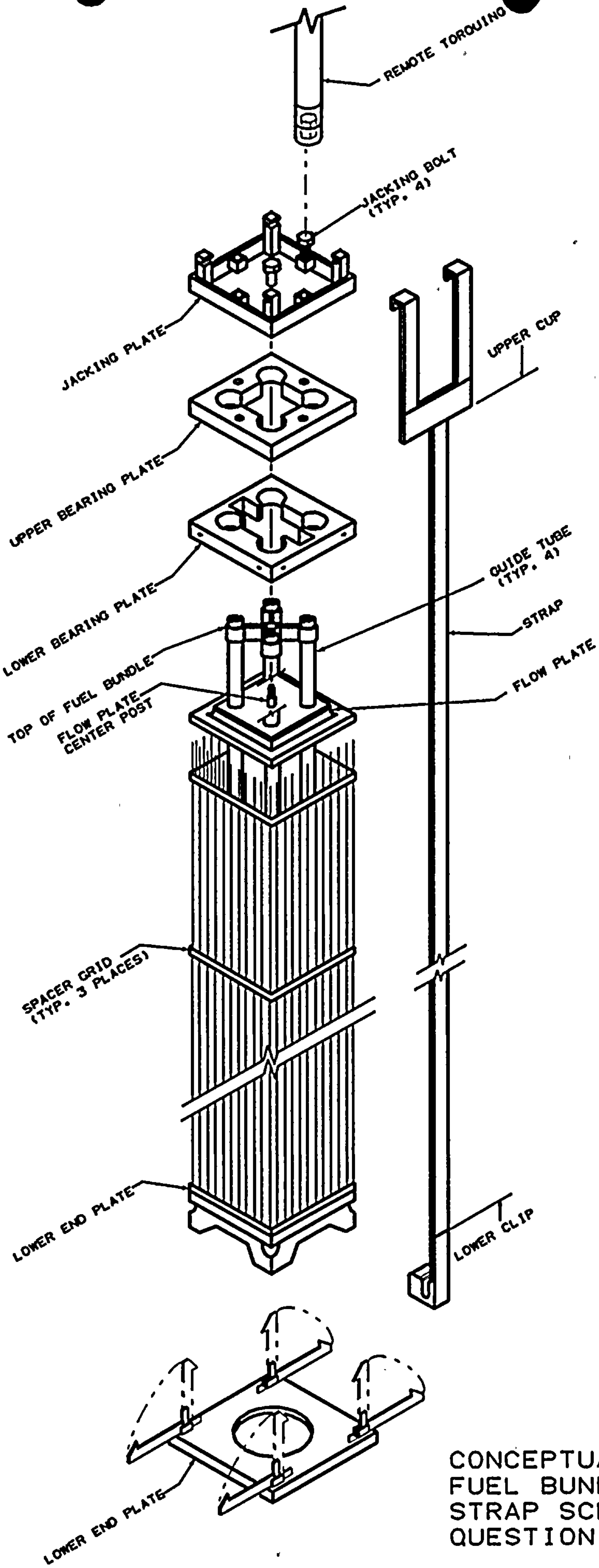
The spotters function will be to visually monitor the fuel bundle during movement to verify that all of the rigging, the external reinforcement devices, and grapple perform as intended and ensure the assembly does not come in contact with obstructions as it is being moved. Fuel assembly movement will be observed through a remote camera and direct visual observation.

Communications among the crew during fuel assembly movement will be verbal, face-to-face communications, with repeat backs, in accordance with existing conduct of shift operations procedures. In addition, the LSRO will be in constant communication, using headsets, with the Control Room. Management will also be present on the refueling bridge in an oversight function during the manipulation.

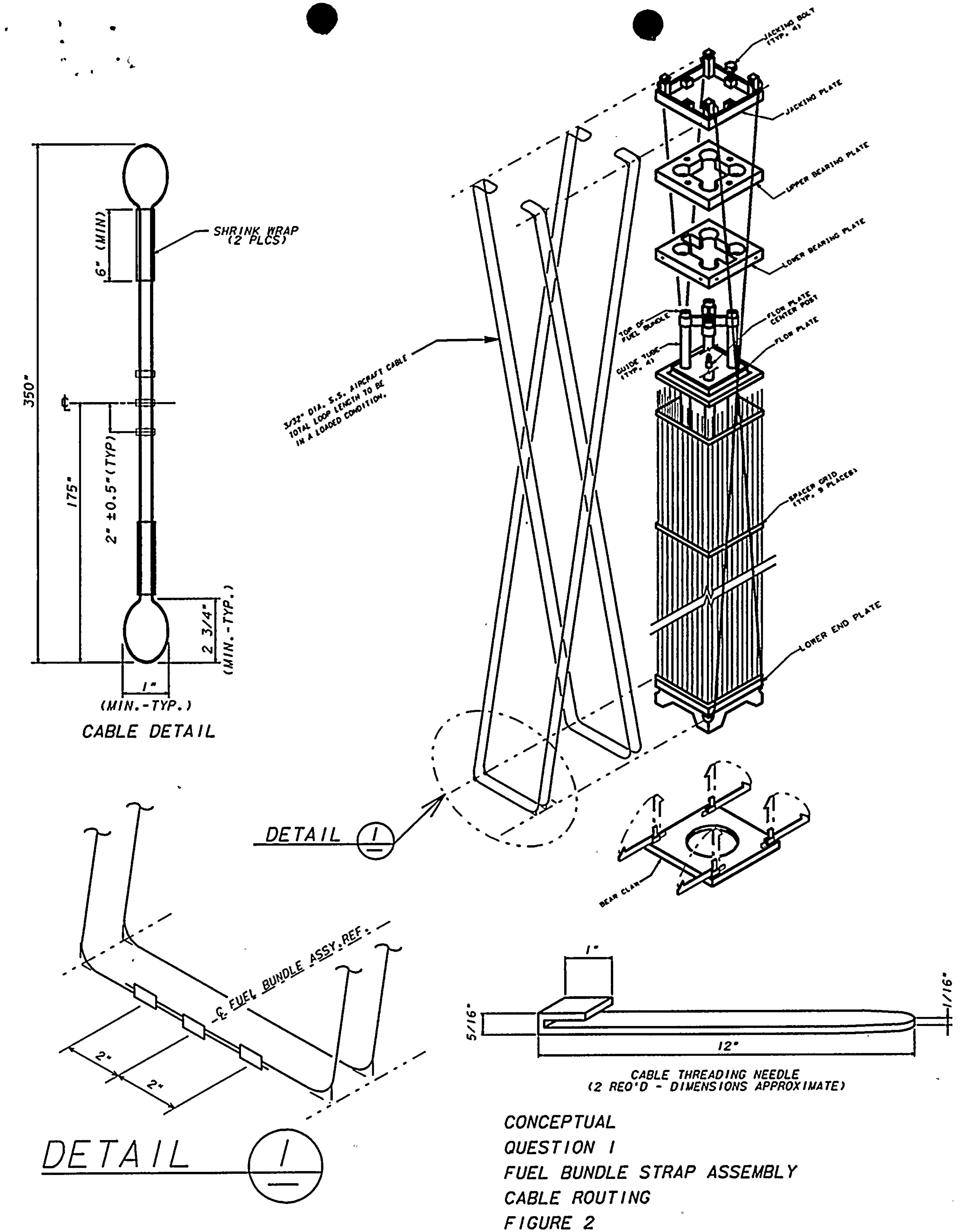
15. **Describe what is meant by free-fall and how the hoist prevents it.**

Response:

Page 6 of the April 1, 1996, amendment request states that the hoist design will not allow the assembly to free-fall while it is being suspended. This means that when the fuel assembly is being suspended by the hoist and is not being raised or lowered, design features of the hoist will prevent the assembly from lowering inadvertently. The hand operated chain hoist has a Weston (mechanical load or friction) brake which prevents the load from moving downward unless the load is manually lowered using the hand chain. The hoist meets the requirements of ASME B30.16-1993, "Overhead Hoist (Underhung)."



CONCEPTUAL
FUEL BUNDLE STRAP ASSEMBLY
STRAP SCHEME
QUESTION 1 FIGURE 1



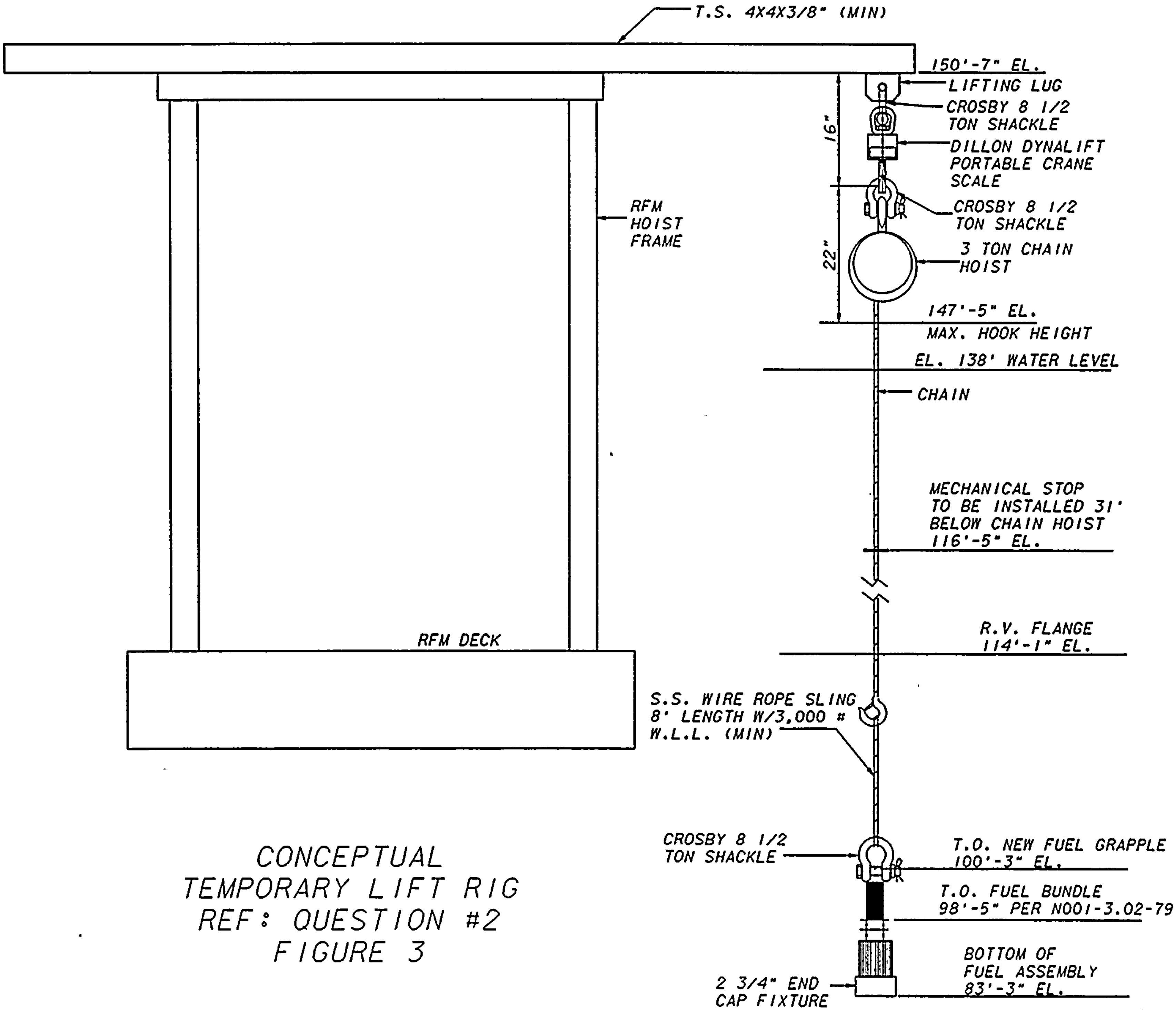
CONCEPTUAL

QUESTION I

FUEL BUNDLE STRAP ASSEMBLY

CABLE ROUTING

FIGURE 2



CONCEPTUAL
TEMPORARY LIFT RIG
REF: QUESTION #2
FIGURE 3