UNITED STATES
NUCLEAR REGULATORY COMMISSION
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MEMORANDUM FOR: LeMoine J. Cunningham, Chief
Radiation Protection Branch
Division of Radiation Protection
and Emergency Preparedness, NRR

THRU: James E. Wigginton, Section Chief
Radiation Protection Branch
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FROM: Charles S. Hinson, Health Physicist
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SUBJECT: TRIP REPORT - INFORMATION GATHERING VISIT TO PALO VERDE PLANT, NOVEMBER 4-6, 1991

On November 4-6, 1991, Dan Carter and I conducted an information gathering visit to the Palo Verde Nuclear Generating Station near Wintersburg, Arizona. The purpose of this visit was to evaluate the plant layout and design features for Palo Verde (which is a System 80 design plant) in an attempt to identify any areas where modifications or design changes could be made to reduce overall plant collective person-rem. These identified plant improvement areas will then be incorporated into the ongoing design review for the advanced CESSAR System 80+ design.

Prior to the plant visit, we sent the licensee a list outlining several areas of concern that we would like to discuss with them during our plant visit. A copy of this list of concerns is attached as Enclosure 1.

We arrived on site on November 4, 1991. After taking the required site specific training and receiving a whole body count, we met with William Barley, manager of RP Technical Services. The rest of the day was spent discussing the licensee's responses to our list of concerns. At the end of the day, John Gaffney (RP Outage Planning Supervisor) demonstrated the use of a small mobile robot that was to be used to measure radiation levels in the Unit 2 hot leg prior to replacing the hot leg instrument taps during the ongoing Unit 2 outage.

On Tuesday, November 5, Wayne McMurry (Senior Technical RP Advisor-Unit 3) escorted Dan and myself through the Unit 3 Auxiliary Building in the morning and through the Unit 2 Containment Building in the afternoon. These tours

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focused primarily on those locations where poor design (e.g. exposed or insufficiently shielded radioactive piping or equipment, unshielded or poorly located sample points, lack of permanent scaffolding in areas requiring frequent maintenance/ISI) or the presence of hot spots has resulted in unplanned localized high radiation areas.

On Wednesday, November 6, we met with the licensee again to discuss any remaining issues not previously discussed from our list of concerns. Overall, the plant visit was very informative and worthwhile. The licensee was very cooperative and was prepared to discuss each of the items contained in our list of concerns. A brief description of our findings for each of the five main categories in the list is provided as Enclosure 2.

The average dose per unit at Palo Verde over its operational lifetime (1987-1990) is 261 person-rems. This is less than the 1990 PWR average dose per unit of 291 person-rems. Palo Verde's relatively low average collective dose can be attributed to several factors including the lack of any major maintenance jobs performed to date, the relatively young age of the plant, and spaciousness of the plant layout (which facilitates plant maintenance, thereby resulting in lower personnel doses). Inspite of Palo Verde's low average collective dose, we were able to identify several areas which, if redesigned, would further aid in reducing the plant collective dose. We will factor these findings into our design review of the advanced CESSAR System 80+ design.

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Enclosures:
As stated

1. Dose Rates/Contamination Levels (Are there parts of the plant where the average radiation levels exceed original design levels?)

   - o Hot spot areas
   - o Contaminated areas
   - o High airborne areas
   - o High radiation areas (due to crud levels, inadequate shielding)

2. Component/System Modifications (Are there components or systems at the plant which could be modified, redesigned, eliminated, relocated, or shielded in order to reduce the personnel dose rates associated with operation/maintenance of these components/systems?) Some components/systems to consider would include:

   - o RTD bypass manifolds (replacement with thermowell mounted RTDs)
   - o Heat exchangers (improved corrosion resistance of tubes)
   - o Steam generators (adaptability for robotic ECT and tube plugging, secondary side accessibility, corrosion resistance of tubing)
   - o Filter/demineralizers (adequate shielding)
   - o Fuel transfer tube (adequate shielding)
   - o Snubbers and hangers (reduction in number to improve accessibility)
   - o Components/systems with radioactive contents (hookups to permit component/system decontamination)
   - o Scaffolding (permanent vs. portable)
   - o Incore detector room (precautions to prevent personnel overexposure)
   - o Crud trap minimization

3. Operations (Are there ways that the doses associated with the following plant operations can be reduced (e.g. through improved accessibility, increased shielding, design changes, use of robotics and remote viewing equipment)?)

   - o Containment tours
   - o In-service inspections
   - o Refuelings
   - o Staging and scaffolding erection/teardown
   - o Initial power ascension shielding surveys
   - o Radwaste processing

4. Maintenance (Are there ways that the doses associated with the following plant maintenance can be reduced (e.g. through improved accessibility, increased shielding, design changes, use of robotics and/or remote tools)?)

   - o Steam generator maintenance/replacement
   - o Control rod drive changeout
   - o RCP seal replacement

5. Plant Layout (Describe what changes you would make, if any, to the plant layout design to address each of the concerns listed below)

- o Equipment/component accessibility (all equipment/components accessible for maintenance/ISI/replacement)
- o Containment access/exit points (sufficient to accommodate large numbers of outage workers, good traffic flow)
- o Low dose-rate zones (for donning/removing anti-Cs, waiting areas during shift changes)
- o Worker changeout areas (one central location vs. several smaller areas, sufficient lockers for large numbers of outage workers)
- o Very high radiation areas (are there any accessible areas in containment where shutdown radiation levels may exceed 500 R/hr at one meter?)
- o High radiation areas (minimize number of high radiation areas by relocation or shielding of radioactive piping, components, and valves; use of reach rods or remote actuators to operate equipment in high radiation areas)
- o Tanks in entombed rooms (potential for tank overflow)
- o Containment area and airborne radioactivity monitors (location, adequate number of monitors, accessibility for maintenance and calibration)
- o Shielding (adequate, use of permanent vs. portable, provisions for hanging portable shielding)
- o Reactor component lay down areas (adequate space, well shielded)
- o Service lines (are there adequate electrical outlets, air lines, welding connections, supplied air, ventilation hookups, and communication lines in work areas where needed?)
- o HVAC (adequate ventilation flows to minimize airborne radioactivity)
- o Refueling area (reactor cavity seal design, fuel transfer tube flange design)
- o Lighting in radiation areas (redundant, long-life, accessible, adequate illumination, switches in low radiation areas)

6. Other (Describe any other modifications or changes that could be made to reduce the overall plant collective dose (e.g. use of robotics or remote viewing cameras, low cobalt materials, primary water chemistry controls)

ENCLOSURE 2

Brief Listing of Findings

Dose Rates/Contamination Levels

- Overall, the design dose rates were very conservative and, in most areas, have not been exceeded to date.

- The presence of antimony in the reactor coolant pump (RCP) journal bearings and stellite in the RCP wear rings has resulted in a large number of hot particles throughout Units 1 and 2. The bearings and wear rings in question were replaced in Unit 3 before the unit reached full power so there is less of a hot particle problem for this unit.

- Only about one and a half percent of the plant areas are contaminated.

Component/System Modifications

- In order to reduce the number of hot particles in the reactor coolant, the licensee has initiated a program to gradually reduce the size of the purification filter pores in the CVCS from 5 microns to 0.45 microns.

- The fuel upender design incorporates a "catch plate" to catch hot particles shaken loose from fuel bundles during upending and transport. Because of the design of this "catch plate," it is virtually impossible to remove the radioactive debris which accumulates there and the resulting dose rates from the "catch plate" are very high. The licensee is considering drilling holes in the "catch plate" to permit the debris to filter down to the floor of the refueling cavity where it will be easier to remove and dispose of.

- The as-built conical flanges connected to the fuel transfer canal drain lines were unshielded and located in a high traffic hallway. The flanges served as crud traps for all the radioactive debris and hot particles washed down from the full transfer canal area. The licensee has modified these flanges to eliminate this problem.

- The licensee has instituted a snubber reduction program to improve component accessibility. Better accessibility for maintenance and ISI will result in lower overall plant collective doses.

- Some of the plant areas where the installation of permanent scaffolding would serve to improve access and thereby reduce personnel dose during maintenance/ISI are in the radwaste high level storage area, the incore chase leading to the reactor vessel bottom, and between the reactor coolant pumps (to facilitate seal maintenance).

- The licensee is studying the feasibility of replacing many of the stellite containing valves with valves which have no stellite content.

- The seals on the charging pumps are prone to failure and must be replaced frequently. This is of great operational concern since the charging pumps are also used for auxiliary spray.

- The installed radwaste equipment did not function as planned so the licensee had to install a portable radwaste systems in all three units.

- The lack of "U" bend gas traps in the floor drains and the poor air flow balance between floors has resulted in noble gas migration between floors.

- The pressurizer spray valves are poorly designed and require frequent maintenance to prevent leakage of noble gases into containment.

- The pressurizer vent system design does not permit the RCS to be depressurized in a timely manner. Consequently, in order to avoid impacting critical path time during RCS depressurization, the pressurizer is vented directly to the Containment Building.

- The steam generators have no hand holes above the tube sheet area. Hand holes would make the steam generator tubes accessible for sludge lancing and inspection.

Operations

- o The dose to accomplish the following routine operations could be reduced through the following minor design changes:

  - Relocating the sample point for the SIT tanks to outside of containment would eliminate the routine containment power entries now required for SIT tank sampling.

  - Relocating the sample point for taking reactor coolant samples (during shutdown) to the chemistry lab would eliminate the need to enter the Auxiliary Building main hallway to obtain these samples.

  - Having the capability to remotely add oil to the reactor coolant pumps would eliminate the need to go inside the bioshield to perform this operation during operation.

- o The current method used to flood the refueling cavity in preparation for fuel movement is to pump the water up through the core and into the cavity using the safety injection pumps. This method of flooding the cavity results in the flushing of a large number of hot particles from the core into the refueling cavity. An alternate method of core flooding which would not flush as many hot particles into the refueling cavity would be desirable.

o The system used for spent resin transfer has many design flaws (e.g., frequent transfer pump seal failures, ion exchangers located so as to make dose rate readings difficult to obtain).

Maintenance

o The original design reactor coolant pump seals required replacement at each refueling. These seals have been redesigned to extend seal life.

o Doses associated with the installation of steam generator nozzle dams could be reduced through the development of robotics which could remotely perform this task for CE design steam generators.

Plant layout

o The methods used to handle high activity liners/HICS in the high level storage area are archaic and result in the unnecessary expenditure of person-rems.

o The plant layout does not provide adequate space for the storage of radwaste.

- o The design of the spent resin tanks does not permit the remote sampling of resins in these tanks. This necessitates having to sample resins from the radwaste containers prior to disposal which results in higher personnel exposures.

- o The excessive number of obstructions in the refueling cavity makes this area difficult to decontaminate following refueling draindown.

- o There are several radioactive components and piping runs which are inadequately shielded. Some of these radioactive piping runs are routed through walls and floors in the Auxiliary Building. This has resulted in "hot spots" in various hallways and cubicles which exceed the posted radiation zone levels.

- o The following as-built service lines in containment were inadequate to support the required maintenance/refueling work performed and had to be redesigned:

    - Insufficient electrical outlets to support refueling outages.

    - The installed instrument air system was inadequate to serve as a backup system to the breathing air system (due to its nitrogen backup feature).

- As-built lighting in the containment dome provides inadequate illumination of the refueling deck and other levels in containment.

- The regenerative heat exchanger in containment is insufficiently shielded.