UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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MEMORANDUM FOR: James G. Partlow, Associate Director for Projects
Office of Nuclear Reactor Regulation

FROM: Frank J. Miraglia, Associate Director for Inspection and Technical Assessment
Office of Nuclear Reactor Regulation

SUBJECT: RADIOLOGICAL CONTROL MEASURES TO MINIMIZE THE SPREAD OF HOT PARTICLES DURING THE FUEL RECONSTITUTION PROCESS

The purpose of this memorandum is to describe some of the radiological control measures that have been found to help minimize the spread of hot particles during the fuel reconstitution process. Similar information has been provided to Regional offices. Licensees currently perform fuel reconstitution activities under the provisions of 10 CFR 50.59. Therefore, we suggest that when project managers become aware of planned fuel reconstitution activities at their facilities, they should ascertain that their licensees are aware of and have implemented proper control measures.

BACKGROUND

With the advent of more sensitive radiation detectio   tors over the last few years, the number of hot particle (see Enclosure 1 for definition) incidents at nuclear power plants has increased dramatically. The NRC staff and licensees are increasingly aware of maintenance/operational activities which can generate/release hot particles to accessible areas of the plant. Fuel reconstitution is one such commonly performed activity where the potential exists for the spread of hot particles if precautions are not taken during the handling of the fuel pins.

Fuel reconstitution is a com   ractice used at nuclear power plants to remove damaged or leaking fuel pins from spent fuel assemblies and replace them with non-leaking fuel pins. This procedure is performed in the spent fuel pool and is usually performed by trained vendor personnel. Because this operation is

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performed on degraded fuel pins which may be brittle and have crud deposit on them, the licensee should employ special techniques and precautions for handling these fuel pins to prevent rupture of the cladding and subsequent dispersal of fuel particles into the pool (see Enclosure 2 - Information Notice on control of hot particle contamination). In 1985, while reconstituting fuel at San Onofre Unit 3, a fuel pin was inadvertently pulled apart and several fuel pellets fell to the fuel pool floor where they broke into small fuel fragments. Because of the lack of proper radiological controls, some of these fuel fragments then spread through the plant spent fuel systems and to the liquid radwaste systems. Following this event, the number of hot particle incidents at San Onofre Unit 3 increased dramatically. A similar increase in personnel skin contaminations from hot particles occurred at Trojan in 1982 following in-core fuel damage caused by baffle jet problems.

PROVEN CONTROL MEASURES FOR CONTROLLING HOT PARTICLES

The use of proper radiological controls during the fuel reconstitution process can minimize the spread of hot particles. Listed below are several radiological control measures which some licensees have used successfully during fuel reconstitution work to reduce the likelihood of hot particle contamination.

1. Limit fuel reconstitution operations to a confined section of the spent fuel pool. Some licensees have covered all surfaces in that section to collect any fuel particles or crud that may fall from the assemblies.

2. Use close-capture containment devices (e.g., local vacuum system) in the spent fuel pool to remove any fuel fragments generated from the reconstitution area.

3. Maintain continuous operation of the fuel pool cleanup system during fuel reconstitution.

4. Commit to controlling hot particles in the Fuel Handling Building to prevent their spread from the particle control areas.

5. Maintain dedicated job coverage by qualified health physics personnel with appropriate instruments for monitoring direct radiation and airborne radioactivity.

6. Perform periodic sampling of the spent fuel pool water or survey of the close-capture filter system during fuel reconstitution to detect any step increases in activity and/or particle production which may indicate problems with the reconstitution process.

7. Use well-trained individuals to perform the fuel reconstitution.

8. Ensure that all personnel in the fuel storage area wear proper protective clothing.

9. Survey refueling tooling and equipment for irradiated fuel particles prior to use and before shipping to other facilities.

10. Use a spraydown system to remove fuel particles from tools being removed from the pool. Also wipe tools dry upon removal.

Project managers may request, as appropriate, PRPB technical assistance for those cases where further guidance is necessary. Any questions concerning this memorandum should be directed to Charles Hinson, PRPB, x23148.

Original signed by
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Enclosures:
1. Hot particle definition
2. Information Notice

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DEFINITION AND DESCRIPTION OF HOT PARTICLES

Hot particle, fuel flea, and discrete radioactive particle are terms used to describe similar types of radioactive contamination. Hot particles have the following characteristics:

- small physical size, at times with a diameter as small as approximately 3 microns
- high specific activity, normally in the microcurie range, but sometimes in the millicurie range
- high local dose rate, some have exceeded 20,000 rad/hr beta surface dose rate

Hot particles appear to have two principle origins:

1. Irradiated fuel material enters the primary coolant through fuel cladding failures during plant operating and fuel handling evolutions. This allows fuel fragments to enter the work area when primary coolant systems are opened for maintenance or repair. Fuel fragments and some corrosion products tend to have a high electrostatic charge and will "jump" from one surface to another in a given circumstance. Hence, the name "flea."

2. Cobalt, manganese and other metals used in the manufacture of valves, piping and vessels enter the coolant as products of corrosion and erosion and undergo neutron activation when entering the reactor core region. Additionally, debris can enter the primary system during maintenance and also be activated. These products and materials enter the work area when coolant systems are opened for maintenance or repair.

The ability to detect hot particles is a function of instrument design and limitation. Highly sensitive personnel contamination monitors were introduced about three years ago and their increased use coincides with an increase in the detection frequency of hot particles. Once aware of hot particle contamination, a plant can perform additional surveillance in areas likely to contain them. Enhanced survey techniques can then be used to locate and isolate the particles.