GE Nuclear Energy

General Electric Company
175 Curtner Avenue, San Jose, CA 95125

March 10, 1994

Docket No. 52-001

Chet Poslusny, Senior Project Manager
Standardization Project Directorate
Associate Directorate for Advanced Reactors
and License Renewal
Office of the Nuclear Reactor Regulation

Subject: Submittal Supporting Accelerated ABWR Schedule - **Materials Selection Portion of Open Item F1.9-1**

Dear Chet:

Enclosed is a revised respone to the materials selection portion of Open Item F1.9-1.

Please provide a copy of this transmittal to Roger Pedersen.

Sincerely,

Jack Fox

Jack Fox
Advanced Reactor Programs

cc:	Alan Beard	(GE)
	Hal Careway	(GE)
	Norman Fletcher	(DOE)
	Joe Quirk	(GE)

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Stellite is used for hard facing of components which must be extremely wear resistant. Use of high cobalt alloys such as Stellite is restricted to those applications where no satisfactory alternative material is available. An alternative material (Colmonoy) has been used for some hard facings in the core area.

and Material Selection

12.3.1.1 Equipment Design for Maintaining Exposure ALARA

12.3.1.1.1 Equipment Design

This subsection describes specific components, as well as system design features, that aid in maintaining the exposure of plant personnel during system operation and maintenance ALARA. Equipment layout to provide ALARA exposures of plant personnel is discussed in Subsection 12.3.1.2.

(1) Pumps

Pumps located in radiation areas are designed to minimize the time required for maintenance. Quick change cartridge-type seals on pumps, and pumps with back pullout features that permit removal of the pump impeller or mechanical seals without disassembly of attached piping, are employed to minimize exposure time during pump maintenance. The configuration of piping about pumps is designed to provide sufficient space for efficient pump maintenance. Provisions are made for flushing and in certain cases chemically cleaning pumps prior to maintenance. Pump casing drains provide a means for draining pumps to the sumps prior to disassembly, thus reducing the exposure of personnel and decreasing the potential for contamination. Where two or more pumps conveying highly radioactive fluids are required for operational reasons to be located adjacent to each other, shielding is provided between the pumps to maintain exposure levels ALARA. An example of this situation is the CUW circulation pumps. Pumps adjacent to other highly radioactive equipment are also shielded to reduce the maintenance exposure, for example, in the Radwaste System.

Whenever possible, operation of the pumps and associated valving for radioactive systems is accomplished remotely. Pump control instrumentation is located outside high radiation areas, and motor or pneumatic-operated valves and valve extension stems are employed to allow operation from outside these areas.

(2) Instrumentation

Instruments are located in low radiation areas such as shielded valve galleries, corridors, or control rooms, whenever possible. Shielded valve galleries provided for this purpose include those for the CUW, FPCC, and Radwaste (cleanup phase separator, spent resin tank, and waste evaporator) Systems. Instruments required to be located in high radiation areas due to operational

(8) SGTS Filters

The SGTS filter is located in a separate shielded cubicle and is separated by a shield wall from the exhaust fans to reduce the radiation exposure of personnel during maintenance. The dampers located in the cubicles are remotely-operated, thus requiring no access to the cubicle during operation. A pneumatic transfer system is employed to remove the radioactive charcoal from the filter, requiring entry into the shielded cubicle only during the connection of the hoses to the SGTS filter unit.

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12.3.1.2 Plant Design for Maintaining Exposure (ALARA)

This subsection describes features of equipment layout and design which are employed to maintain personnel exposures ALARA.

(1) Penetrations

Penetrations through shield walls are avoided whenever possible to reduce the number of streaming paths provided by these penetrations. Whenever penetrations are required through shield walls, however, they are located to minimize the impact on surrounding areas. Penetrations are located so that the radiation source cannot "see" through the penetration. When this is not possible, or to provide an added order of reduction, penetrations are located to exit far above floor level in open corridors or in other relatively inaccessible areas. Penetrations which are offset through a shield wall are frequently employed for electrical penetrations to reduce the streaming of radiation through these penetrations.

Where permitted, the annular region between pipe and penetration sleeves, as well as electrical penetrations, are filled with shielding material to reduce the streaming area presented by these penetrations. The shielding materials used in these applications include a lead-loaded silicone foam, with a density comparable to concrete, and a boron-loaded refractory-type material for applications requiring neutron as well as gamma shielding. There are certain penetrations where these two approaches are not feasible or are not sufficiently effective. In those cases, a shielded enclosure around the penetration as it exits in the shield wall, with a 90 degree bend of the process pipe as it exits the penetration, is employed.

(2) Sample Stations

Sample stations in the plant provide for the routine surveillance of reactor water quality. These sample stations are located in low radiation areas to reduce the exposure to operating personnel. Flushing provisions are included using demineralized water, and pipe drains to plant sumps are provided to

12.3.7.3 Requirements of 10CFR70.24

COL applicants will provide information showing that their plant meets the requirements of 10CFR70.24 or request an exemption from this 10CFR 70.24 requirement (Subsection 12.3.4.3).

12.3.8 References

12.3-1 N. M. Schaeffer, *Reactor Shielding for Nuclear Engineers*, TID-25951, U.S. Atomic Energy Commission (1973).

12.3-2 J. H. Hubbell, *Photon Cross Sections, Attenuation Coefficients, and Energy Absorption Coefficients from 10 KeV to 100 GeV*, NSRDS-NBS20, U.S. Department of Commerce, August 1969.

12.3-3 *Radiological Health Handbook*, U.S. Department of Health, Education, and Welfare, Revised Edition, January 1970.

12.3-4 *Reactor Handbook*, Volume III, Part B, E.P. Blizzard, U.S. Atomic Energy Commission (1962).

12.3-5 Lederer, Hollander, and Perlman, *Table of Isotopes*, Sixth Edition (1968).

12.3-6 M.A. Capo, *Polynomial Approximation of Gamma Ray Buildup Factors for a Point Isotropic Source*, APEX-510, November 1958.

12.3-7 Reactor Physics Constants, Second Edition, ANL-5800, U.S. Atomic Energy Commission, July 1963.

12.3-8 ENDF/B-III and ENDF/B-IV Cross Section Libraries, Brookhaven National Laboratory.

12.3-9 PDS-31 Cross Section Library, Oak Ridge National Laboratory.

12.3-10 DLC-7, ENDF/B Photo Interaction Library.

12.3.7.4 Material Selection

The COL applicant should ~~further reduce maintenance exposure through material selection as described in Subsection 12.3.1.1.2.~~ shall address state-of-the-art developments in material selection options for maintaining exposure ALARA.

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12.3.1.1.2 Material Selection

In the ABWR design maintaining radiation exposure ALARA has been considered in the material selection of systems and components exposed to reactor coolant. For example, radiation exposure potential has been reduced appreciably through the removal or reduction of cobalt from many components as compared to the current BWR fleet. Much of the cobalt is removed from contact with reactor coolant by eliminating Stellite where practical and reducing cobalt in the core stainless steel components. The cost of using very low cobalt materials through out the plant is prohibitive with the cost of 0.02 wt percent cobalt stainless steel approximately 8 times that of 0.05 wt percent stainless steel. Therefore, the ABWR design has taken a graded approach by using the most expensive though lowest cobalt bearing materials in the most radiologically significant areas with increasing cobalt content in less sensitive areas. The ABWR standards for cobalt are: 0.02 wt percent for those items in the core; 0.03 wt percent for those items in the vessel internals; and 0.05 wt percent for all other components. Also, with the current materials, there are no proven substitutes for Stellite for many hard surface applications such as MSIV seats. Current efforts by the nuclear and metallurgical industry indicate that in the future, practical alternatives to Stellite maybe feasible and are being researched.

The COL applicant shall address material selection of systems and components exposed to reactor coolant to maintain radiation exposures ALARA. See Subsection 12.3.7.4 for COL license information requirements.