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PDR

July 2, 1993
RAC:93:091

SPC submission
June 30, 1992

Dr. S. L. Wu
Reactor Systems Branch
Division of Engineering and System Technology
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Dr. Wu:

SPC Annual Fuel Performance Report

Attached is the 1991 update of the performance of the fuel manufactured by Siemens Power Corporation. This attachment uses the same format as the report for the 1990.

If you have questions, or if I can be of further assistance, please contact me.

Very truly yours,

R. A. Copeland, Manager
Product Licensing

/smg

Attachment

cc: Mr. C. E. Beyer (PNL)

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Siemens Power Corporation
Nuclear Division - Engineering and Manufacturing Facility
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Siemens Power Corporation

1991 Fuel Performance

As of December 31, 1991, fuel manufactured by Siemens Power Corporation (SPC), formerly Advanced Nuclear Fuels Corporation, had been loaded into 51 commercial light water reactors in the United States, Europe, and Asia, including 25 BWRs and 26 PWRs. SPC fuel had also been supplied to the LOFT test reactor.

By the end of 1991, a total of 19,915 fuel assemblies comprising 2,378,153 fuel rods had been irradiated. Of these, 12,826 assemblies were irradiated in BWRs and 7,089 assemblies were irradiated in PWRs. SPC fuel experience is summarized in Table 1. The distribution of SPC fuel versus burnup is shown for BWRs in Figure 1 and for PWRs in Figure 2.

The highest exposures reached by SPC fuel assemblies to date are 52.1 GWd/MTU in the R. E. Ginna PWR in New York, and 45.1 GWd/MTU at the Big Rock Point BWR in Michigan. The highest exposure reached by a BWR 9x9 fuel assembly is 40.1 GWd/MTU at Gundremmingen-C in Germany. Individual extended burnup BWR rods reached 48.9 GWd/MTU. The new high burnup for PWR 17x17 fuel assemblies reached during 1991 is 51.8 GWd/MTU at Unterweser in Germany. BWR 9x9 and PWR 17x17 fuel are more resistant to failure because of reduced linear heat generation rates. Additional benefits are lower fuel temperatures, less fission gas release, decreased pellet-clad interaction and lower clad stresses.

Through 1991 SPC fuel rod integrity remained better than 99.998%. To assess the overall performance of SPC fuel, SPC uses the INPO Fuel Reliability Indicator (FRI). The FRI for PWRs is the Iodine-131 coolant activity level normalized to a standard cleanup system flow rate and corrected for tramp uranium. For BWRs the FRI is determined from the rate of fission gas release measured at the steam jet air ejector. Lower FRI values are indicative of fewer failed rods in the core. The FRI distribution for SPC PWR and BWR fuel is shown in Figure 3. This information is derived from the 1991 yearly average for each reactor that operated with SPC fuel in the core. The information shown in Figure 3 indicates that SPC fuel performed to the industry standard in 1991. SPC did not have any warranted fuel failures attributed to design or manufacturing in 1991. The five-year trend in the SPC FRI indicates a continued improvement in fuel performance.

During 1991, leaks in cladding attributable to causes other than fuel design or manufacturing were found to be from trapping or lodging of debris from the coolant stream where it could cause fretting of the cladding.

SPC standard and beta-quenched cladding continued to show good corrosion performance in all reactor environments based on corrosion data collected during 1991. These data were obtained at seven PWRs and six BWRs. Beta-quenched cladding rods reached exposures as high as 48.9 GWd/MTU and exhibited superior corrosion performance in BWRs, particularly in those BWRs which are susceptible to Crud Induced Localized Corrosion (CILC).

TABLE 1
SUMMARY OF SPC FUEL
EXPERIENCE THROUGH 1991

A. FUEL ASSEMBLIES

	In Core through 1991		Discharged in 1991 or Before		
Reactor Type	Quantity	Max. Burnup GWd/MTU	Quantity	Max. Burnup GWd/MTU	Total Quantity
BWR	8,171	40.1	4,655	45.1[1]	12,826
PWR	2,200	51.8	4,889	52.1	7,089
Total	10,371		9,544		19,915

B. FUEL RODS

Reactor Type	In-Core	Discharged	Total
BWR	575,997	294,224	870,221
PWR	493,590	1,014,342	1,507,932
Total	1,069,587	1,308,566	2,378,153

[1] Average of extended burnup rods transferred to a new host fuel assembly.

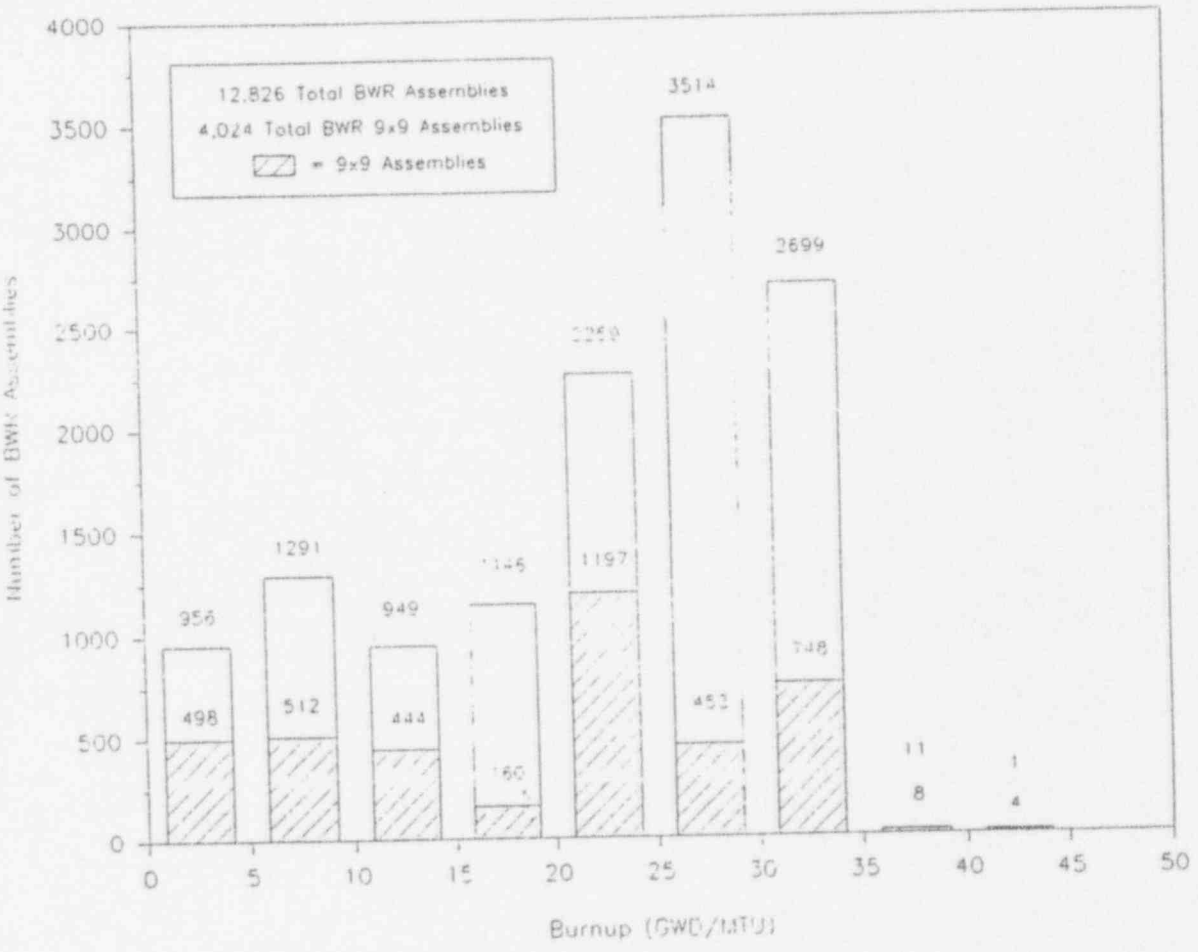


FIGURE 1 EXPOSURE OF IRRADIATED SPC BWR FUEL ASSEMBLIES

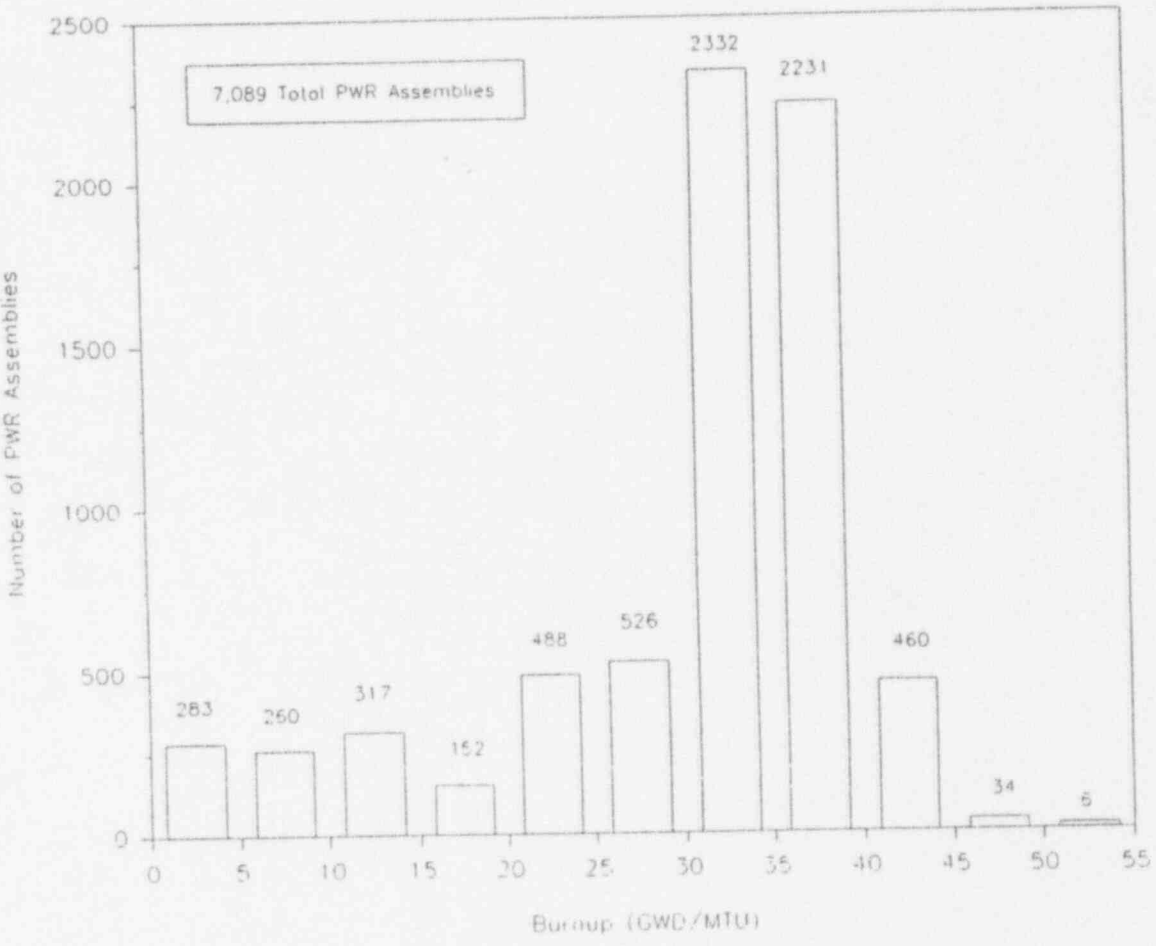
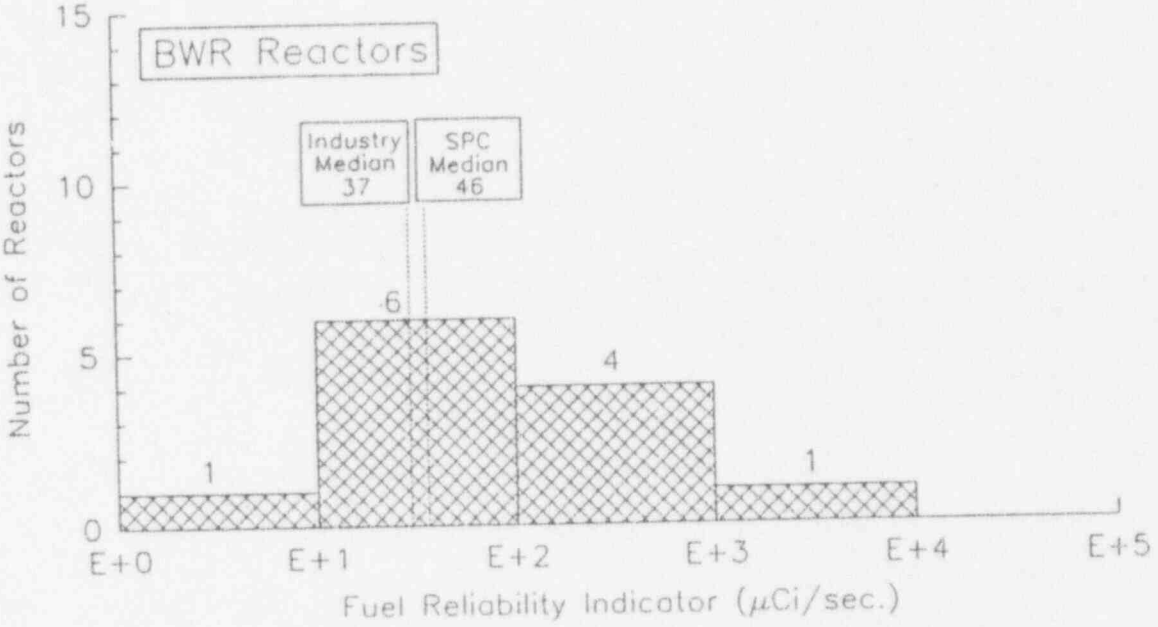


FIGURE 2 EXPOSURE OF IRRADIATED SPC PWR FUEL ASSEMBLIES
AS OF 12/31/91

FUEL RELIABILITY INDICATOR – INPO METHOD
Reload Quantities of SPC Fuel for 1991



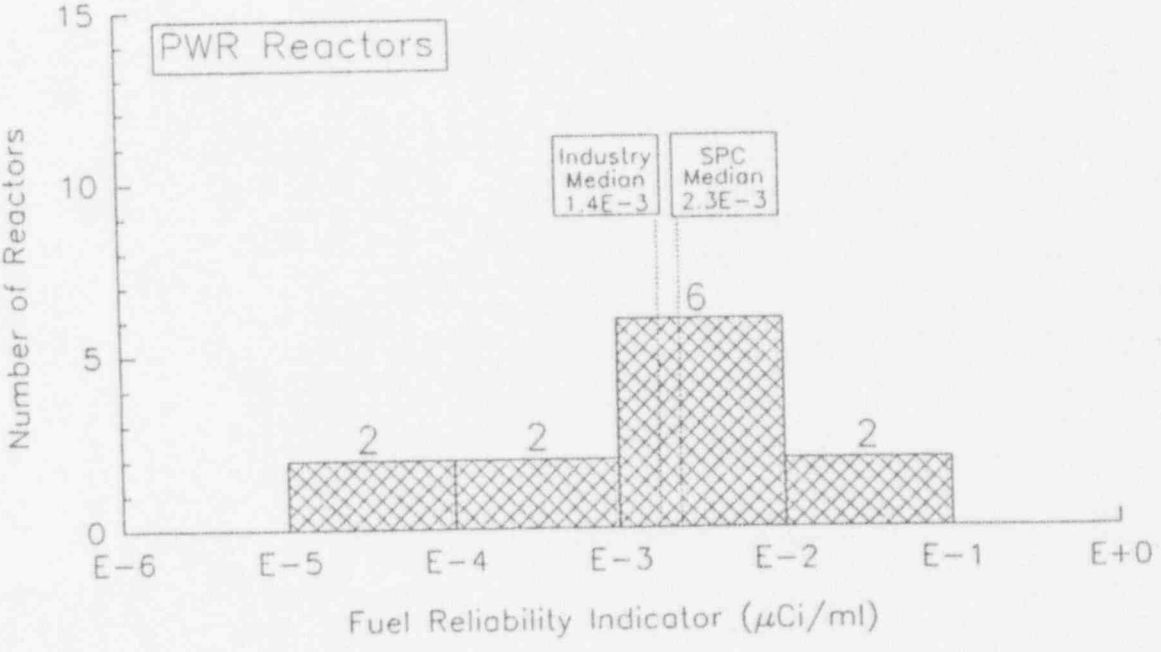


FIGURE 3