ENCLOSURE 1

OAK RIDGE NATIONAL LABORATORY
OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

April 5, 1990

C. W. Nilsen
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Mail Stop NL/S-217C
Washington, D.C. 20555

Dear Chuck,

Part of the project to revise the decay heat rates in Regulatory Guide 3.54 is the comparisons of results from heat rate measurements with those predicted by ORIGEN-S/SAS2. The comparisons are to be used in both the validations of the calculated data and the determination of safety factors.

One set of decay heat rate measurements involved spent-fuel assemblies near 2.5 years cooling time from the Turkey Point Reactor Unit 3. At cooling times less than about 7 years, possible variations in the operating power history can cause significant changes in the decay heat. In the past, it was assumed that the fuel had a constant power and 3 equal irradiation cycle times (see attachment). It appears that the uncertainty in this history could diminish the value of comparisons of results.

Thus, with regards to the above problems, I am asking you to request the utility to obtain or provide satisfactory operating power histories for the following fuel assemblies: D-15, D-22, D-34 and B-~~34~~. 43

It is possible that the NRC Office of Reactor Regulation might also have this information. We have the total burnups of the assemblies and their measured decay heats at various cooling times. The assemblies resided in the reactor during part of the first 4 cycles. The histories could be provided in the most easily available form. They could be average powers (or relative average powers) per assembly vs time. Or, if preferred, the data could be relative power for the entire reactor vs time. In the latter case accumulative burnups per assembly for each cycle would be needed. In order to save time, the data does not need to be given in an extensively formal form (e.g. use of photo copies is adequate).

Your assistance in obtaining this requested data is deeply appreciated. If you have any questions or need additional information, please contact Cecil Parks (FTS- 624-5280) or me (FTS-624-5256).

Sincerely,

O. W. Hermann

O. W. Hermann
Reactor and Fuel Cycle
Analysis Section

OWH:wm

cc: C. V. Parks
R. M. Westfall

ENCLOSURE 2

TC-1759

A COMPARISON OF MEASURED AND CALCULATED DECAY HEAT FOR SPENT FUEL NEAR 2.5 YEARS COOLING TIME

Hanford Engineering Development Laboratory

F. Schmittroth
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August 1980

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Prepared for the U.S. Department of Energy
under Contract No. DE-AC14-76FF02170

HEDL-TME 83-32
UC-85

ORIGEN2 CALCULATIONS OF PWR SPENT FUEL DECAY HEAT COMPARED WITH CALORIMETER DATA

18

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The results are given in Table 2 and, again, show a remarkable degree of consistency. The calculations are biased low by 3.7% with a scatter (1 σ) of <1% about this bias. As before, the recirculation data for one assembly (C-64) is inconsistent with the static data and the ORIGEN2 calculation. For assembly C-52, five static tests and two recirculation tests were conducted to demonstrate system repeatability. In this case, the values reported in Table 2 are averages, and the static and recirculation results are consistent. The calculation was in much better agreement with the static measurement and was used in the consistency checks noted above.

TABLE 2

COMPARISON OF WEPCO
DECAY HEAT CALCULATIONS AND MEASUREMENTS

Assembly	Burnup (MWd/MTU)	Cooling Time t_c (d)	Decay Heat (W) Meas	Calc	C/E
C-52	31,914	1635	724*	694.5	0.959
C-52	31,914	1635	723**	694.5	0.961
C-56	38,917	1634	921	893.1	0.961
C-64	39,384	1633	931*	907.8	0.975
C-64	39,384	1633	825**	907.8	1.100
C-66	35,433	1630	846	809.2	0.957
C-67	38,946	1629	934	896.1	0.959
C-68	37,057	1630	874	851.4	0.974

*Static test.
**Recirculation test.

3.5 TURKEY POINT RESULTS

Calculations for the Turkey Point assemblies were completed earlier and reported in Reference 1. Since that time, three new calorimeter measurements on these assemblies have been made. For completeness, four earlier results are also included. The ORIGEN2 input data are again included in the Appendix. The calculations were made with an early release of the ORIGEN2

code. In order to ensure that the results are the same when using the most recent release of ORIGEN2, selected calculations were repeated. The differences were negligible and were not considered further.

The results are presented in Table 3. Except for D-04 and the second measurement on D-15, the results are excellent. It is known that thermal equilibrium had not been established in the calorimeter for the D-04 measurement, thus biasing the measured value low. There is reason to believe the same is true for the low D-15 measurement, especially since this measurement is at a cooling time between two neighboring times where the agreement is good. For the remaining five measurements, the calculations are biased high by 3.8% with a scatter (1 σ) of 2.4%. This agreement is well within the uncertainties associated with the measurement and calculations including uncertainties on the reactor operating history.

TABLE 3

COMPARISON OF TURKEY POINT
DECAY HEAT CALCULATIONS AND MEASUREMENTS

Assembly	Burnup (MWd/MTU)	Cooling Time t_C (d)	Decay Heat (W) Meas	Calc	C/E
D-04	28,430	913	1385	1555	1.123
D-15	28,430	962	1423	1491	1.048
D-15	28,430	1144	1126	1217	1.081
D-15	28,430	2077	625	642	1.027
D-22	26,485	963	1284	1357	1.057
D-34	27,863	864	1550	1640	1.058
B-43	25,595	1782	637	638	1.002

elemental oxygen were included. Finally, rounded values of 200 lb of Ziracloy, 28 lb of Inconel, and 2 lb of stainless steel were input, scaled to the elemental inventories given in Table A.4.

A.3 TURKEY POINT ASSEMBLIES

A.3.1 POWER HISTORY

The assemblies studied include one Unit 3, Region 2 assembly (B-43) irradiated in Cycles 1 and 2, and four Unit 3, Region 4 assemblies (D-04, D-15, D-22, D-34) irradiated in Cycles 2-4.

The D assemblies were all irradiated for 851 EFPD during a residence time of 1073 days. This history was modeled by three full-power periods of 284 days, 284 days, and 283 days separated by two shutdown periods of 111 days each. The B-assemblies were irradiated to 827 EFPD during a residence time of 1382 days. The early part of Cycle 1 included an extended period at low power, so that the entire residence time was not modeled. Instead, the power history was assumed to consist of three full-power periods of 259 days, 284 days, and 284 days separated by two 111-day shutdown periods to be consistent with the D assembly irradiations.

Burnups were also available and are given in Table A.7. The assembly powers (given in Table A.7) were computed from the reported burnups and the number of EFPD.

A.3.2 ASSEMBLY MATERIAL INVENTORIES

Table A.7 also gives the uranium mass and its enrichment for each assembly. Oxygen in the fuel was again taken to be 8406 g-at./MTU. Each Turkey Point assembly included 18.84 kg of 304 SS, 4.65 kg of Inconel-718, and 110.0 kg of Zircaloy-4, as given in Table A.4

TABLE A.7

TURKEY POINT ASSEMBLY DATA

Identifier	Discharge Date	EFPD	Burnup (MWd/MTU)	Assembly Power (MW)	Uranium (kg)	Enrichment (wt%)
D-04	11-19-77	851	28,430	15.27	457	2.556
D-15	11-19-77	851	28,430	15.27	457	2.556
D-22	11-19-77	851	26,485	14.22	457	2.556
D-34	11-19-77	851	27,863	14.96	457	2.556
B-43	10-25-75	827	25,595	13.87	448	2.559