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Volume 1

Evaluation of Power Reactor Fuel Rod Analysis Capabilities

Phase 2 Topical Report

Volume 1: Data Evaluation

Prepared by D.R. Coleman

Control Data Corporation

Prepared for
U.S. Nuclear Regulatory
Commission

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ABSTRACT

The acquisition, review, analysis, and processing of power reactor fuel performance data resources is described in this report. These data resources are characterized here to support subsequent evaluations of the NRC-sponsored fuel rod behavior code, FRAPCON.

Application of the Fuel Performance Data Base is shown to provide the basic data files which are sorted, processed, and restructured to establish key parameters of interest on an individual rod basis. The design, operational, and performance parameters are analyzed to determine the data populations and the representation of various fuel design types in the data sample. Also presented are the performance data distribution and trends relative to operational parameters such as power and burnup, and a description of the data processing methods.

Significant amounts of power reactor fuel performance data are available to support high burnup code evaluation studies. The data clearly indicates the cumulative effects of rod deformation, fission gas release, and corrosion, which tend to alter the as-built fuel rod thermal and mechanicalconditions. The available data reflect the current status of commercial fuel utilization in that incumbent designs are gradually being replaced by high burnup designs, but the newer fuel types do not yet dominate the data sample.

SUMMARY

The Nuclear Regulatory Commission's Division of Accident Evaluation (DAE) is sponsoring a fuel behavior research program entitled "Evaluation of Power Reactor Fuel Performance Analysis Capabilities". The main program objective is to evaluate the accuracy of the DAE-sponsored fuel rod behavior code (FRAPCON) for application to commercial fuel design and operational conditions. Pursuit of this objective requires the acquisition, review, analysis, and processing of relevant power reactor fuel performance data resources. The present report updates the status of data evaluation activities for this program.

The available data resources are generated by numerous fuel rod surveillance programs currently sponsored by EPRI and DOE. These programs are intended to promote overall improvements in nuclear fuel management by utilities, but they also yield considerable amounts of both cyclic and end-of-life materials performance data. This post-irradiation exam (PIE) data is indicative of the cumulative thermal, mechanical, and chemical effects of irradiation on the as-built fuel rod configuration; namely, fission gas release, fuel and cladding deformation, and corrosion. Considering the impending nature of high burnup fuel management practice and licensing submittals by industry, it is relevant at this time to apply the available data resources to an evaluation of the FRAPCON code predictive capability.

The specific data requirements include fuel design, operational, and performance parameters. Documentation of these parameters for the rods of interest is currently available under license agreement from the EPRI Fuel Performance Data Base (FPDB). Application of the data base management software package (RIMS) allowed identification of a 233 rod FPDB data sample. RIMS was again used to transfer relevant FPDB parameters for these rods to separate files for subsequent processing on CYBERNET. Additional data files were manually established in the FPDB format for 60 high burnup rods from DOE programs. The raw data files were "filtered", sorted, organized, and modified, when necessary, to produce "master" data files for each rod. The data for these 293 rods together represents the current priority data sample for power reactor evaluation of fission gas release, internal pressure, fuel and cladding deformation, and corrosion models in FRAPCON.

The data sample was characterized relative to the frequency, distribution, and influence of various design, operational, and performance parameters. The main results can be summarized as follows:

1. Between 48 and 211 rods are represented in each of the 7 fuel rod

material performance categories considered; these rods together produce between 80 and 1900 data points in each category.

2. Compared to the initial data evaluation phase, the current data sample more equally reflect the design and performance characteristics of "older" (7x7, 14x14, 15x15) and "newer" fuel designs (8x8, 16x16, 17x17).

3. Operational conditions for the data sample mainly correspond to moderate power (5 - 7 KW/FT) operation to burnups of 20-40 GWD/MTM.

4. The data exhibit physically reasonable thermal, mechanical and chemical burnup effects such as fission gas diffusion kinetics, fuel swelling, cladding creepdown, and surface corrosion.

5. The data responses to power and burnup variation are qualitatively consistent with published fuel performance trends from independent sources.

It is expected that in-place fuel surveillance programs will continue to provide performance data for the "newer" fuel designs and for burnups in excess of 40 GWD/MTM. The currently available FPDB data sample is adequate to support the interpretation of steady state fuel performance calculations up to 40 GWD/MTM.

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ACKNOWLEDGEMENTS

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1.0 INTRODUCTION

The Nuclear Regulatory Commission's Division of Accident Evaluation (DAE) is sponsoring a fuel behavior research program entitled "Evaluation of Power Reactor Fuel Performance Analysis Capabilities" This program is being conducted by Utility Associates International (UAI), a consulting service within Control Data Corporation's Professional Services Division.

As its title indicates, the main objective of the UAI program is analytical in nature; namely, to evaluate the accuracy of the DAE-spnsored steady state fuel rod material behavior code, FRAPCON (1,2,3), for application to commercial fuel design and operational conditions. The evaluation of FRAPCON capabilities for power reactor applications contributes to the overall objectives of other DAE fuel behavior research programs; namely,

1.) To achieve a detailed physical understanding of nuclear fuel response under both normal and off-normal conditions, and

2.) To support the development and application of advanced best-estimate (BE) codes by which the safety margins resulting from conservative licensing analyses can be demonstrated.

During each phase of the program, available results from EPRI and DOE sponsored power reactor fuel surveillance programs are first acquired, reviewed, and analyzed to provide the basic code input and fuel performance data. This data is then applied to the generation of FRAPCON predictions, the systemmatic comparison of predicted and measured fuel performance parameters, and the interpretation of results to identify BE code capabilities and outstanding model development requirements. The UAI program activities are documented in the form of Data and Code Evaluation Reports.

The following sections document the second data evaluation phase of the program. Section 2 identifies the power reactor data resources and describes the data acquisition procedures. Section 3 presents results of the data review function in terms of data categories selected for emphasis and the range of design and operating parameters represented in the data acquired. Section 4 analyzes the performance data quantitatively relative to frequency, distribution, and the effects of design and operational parameters on the measured values. Section 5 summarizes the data storage, retrieval, and processing methods used to organize and implement the large sample analysis approach used. The Appendices provide supporting details concerning the data acquisition parameters and the key results of data processing activity.

2.0 DATA ACQUISITION

The evaluation of a fuel rod behavior code such as FRAPCON requires the acquisition of special data resources; namely, detailed information on individual fuel rod design, operation, and materials performance parameters. With the exception of coolant activity monitors to detect the incidence of cladding failures in the core as a whole, power reactors are not instrumented to measure fuel rod performance parameters. For this reason, the FRAPCON code development and assessment activity reflected fuel rod behavior data and interpretation of mechanisms based on test reactor irradiations. The data acquisition emphasis for the UAI program is on post irradiation exam (PIE) data generated by long term power reactor fuel rod surveillance programs. These data resources are described below.

2.1 Power Reactor Data Resources

During the past few years, fuel behavior code and data resources have been developed and applied in the power reactor sector by EPRI and DOE sponsored programs. These fuel performance improvement programs have sought to achieve more efficient uranium utilization through improved fuel management methods and physical understanding of core material performance limits. Both standard and advanced fuel designs from each domestic vendor (W, B&W, ENC, CE, GE) are under irradiation with various levels of fuel surveillance being carried out between operating cycles or after discharge. A National Fuel Performance Data Base (FPDB) has been established by EPRI to provide computerized storage, access, and retrieval of the voluminous amounts of data generated by these programs. New data is periodically added to the FPDB as results become available to the current data base manager (S. Levy, Inc.). The present FPDB (4, 5) contains mainly EPRI data* and is available to the UAI program under license agreement.

The large scope of current and planned power reactor fuel performance data resources is summarized in Table 1. EPRI, DOE, and related programs have been differentiated on the basis of participating utility, host reactor, fuel supplier, the fuel design under irradiation, the number of assemblies involved, the type of PIE being performed, and the burnup status at a reference point in time.

TABLE 1: Summary of Current and Planned Power Reactor Fuel Performance Data Resources Generated by EPRI, DOE, and ESEERCO Fuel Surveillance Programs

Item	Sponsor	Utility	Reactor	Vendor	Fuel(a) Design	No. Assy.	Rods	(b) PIE	Assy AVG GWD/MTM (time)
1	EPRI	GPU	Oys.Crk	ENC	7S,8S	7	50-100	P,H	25 (1980)
2	EPRI	Duke	Oconee 2	B&W	15S	2	60	P,H	25 (1977)
3	EPRI	PECO	Pch.Bot. 2	GE	8S	4	60	P,H	32 (1981)
4	EPRI	Vepco	Surry 1	W	17S	2	16	P	16 (1976)
5	EPRI	Vepco	Surry 2	W	17S	2	---	P	14 (1977)
6	EPRI	Com.Ed.	Zion 1	W	15S	2	---	P	39 (1978)
7	EPRI	Com.Ed.	Zion 2	W	15S	4	---	P	55 (1982)
8	EPRI	PGE	Trojan	W	17S	4	---	P	29 (1980)
9	EPRI	YAEC	M.Yankee	CE	14S	1	20	P,H	16 (1977)
10	EPRI	AP&L	ANO-2	CE	16S	6	<300	P,H	12 (1981)
11	EPRI	BG&E	Cal.Clif.1	CE	14S	3	60	P,H	55 (1982)
12	EPRI	Com.Ed.	Dresden 3	GE	7S	5	10	P,H	13 (1975)
13	EPRI	WMP	Pt.Bch.1	W	15S	25	56	P,H	25 (1975)
14	DOE	GPU	Oys.Crk.	ENC	8S	4	64	P	35 (1983)
15	DOE	Duke	Oconee 1	B&W	15S	4	---	P,H	50 (1983)
16	DOE	OPPD	Ft.Calhoun	CE	14S	1	---	P,H	52 (1983)
17	DOE	Vepco	Surry 2	W	17S	1	---	P,H	42 (1982)
18	DOE	CPC	B.Rock Pt	ENC	11S	2	64	P	38 (1982)
19	DOE	AP&L	ANO-2	CE	16S	1	---	P,H	49 (1934)
20	DOE	AP&L	ANO-2	CE	16A	1	42	P,H	~50 (1986)
21	DOE	NSP	Monticello	GE	8S	2	22	P	43 (1982)
22	DOE	AP&L	ANO-1	B&W	15A	4	---	P,H	55 (1986)
23	DOE	Duke	Oconee 1	B&W	15A	5	---	P,H	55 (1989)
24	DOE	CPC	B.Rock Pt	ENC	8A	25	311	P,H	~50 (1985)
25	DOE	Com.Ed.	QC-1	GE	8A	4	---	P,H	~50 (1985)
26	ESEERCO	WPS	Kewaunee	ENC	14A	4	---	P	~50 (1988)
27	ESEERCO	Com.Ed.	Zion 2	W	17S	4	---	H	55 (1982)

a) Number indicates rod bundle array size; "S" means standard design; "A" means advanced design features such as annular pellets, thick cladding, large plenums, coated cladding, non-uniform enrichment, and sphere-pac fuel.

b) "P" implies poolside exam; "H" implies detailed hot cell exam for selected rods.

The "Resolution" column in Table 2 indicates the relative detail of the data required. For example, the minimum detail required would be one data value being representative of some condition that applies to an entire rod. All of the currently needed design parameters are of this type*. For operational and certain performance parameters, data arrays are needed to represent the indicated rod condition at multiple time points or axial positions or both. Performance parameters without arrays indicate end of life conditions based on destructive exams or a "once per rod" event such as cladding failure.

For parameters beyond the degree of resolution indicated in Table 2, the conduct of data and code evaluation analyses would be inconsistent with the intended application of the results. For example, the coolant chemistry history is not considered by FRAPCON, nor does FRAPCON consider the presence of fuel-clad bonding and similar types of very localized data available in the FPDB for a few special rods.

A review of all available FPDB information fields identified a large number (≈200) of specific parameters that met the generic data requirements outlined in Table 2. The following section outlines the data acquisition procedures used to access these parameters.

Some of the earlier EPRI programs listed in Table 1 are completed in terms of the older fuel types having been discharged. The higher burnups are associated with ongoing programs and reflect current industry incentives to demonstrate extended duty capabilities for both standard and advanced fuel types.

The total number of individual fuel rods for which power reactor PIE data will eventually become available in the FPDB is estimated to exceed 2500. Many of these rods, however, are on the peripheral rows of assemblies which yield mainly poolside length change data, a relatively low

*It is recognized that 1) for certain rods, data on the variation of design parameters within the rod is available in the FPDB and 2) FRAPCON options are available to treat such variations. This level of detail however exceeds what is normally necessary for production applications of the code by NRC and has not been emphasized in the current program.

TABLE 2: Simplified Breakdown of Data Requirements for Analysis of Fuel Surveillance Results

Category	Data Requirements	Resolution [(a)]
Design	cladding dimensions	rod
	fuel pellet and stack dimensions	rod
	fill gas pressure and composition	rod
	plenum length	rod
	fuel density and thermal stability	rod
	clad heat treatment or properties	rod
	pellet sorbed gas content	rod
Operational	rod/group/assy power history	rod, t
	rod/group/assy axial power distribution	rod, x, t
	coolant pressure	rod, t
	coolant mass flux	rod, t
	coolant temperature	rod, t
Performance	cladding hoop strain	rod, x, t
	cladding axial strain	rod, t
	fuel axial strain	rod, t
	fission gas release fraction	rod
	internal gas pressure	rod
	internal gas composition	rod
	internal void volume (b)	rod
	cladding surface corrosion	rod, x, t
	cladding integrity (b)	rod

(a) rod, x, t indicate rod, position and time dependence

(b) indicated performance data not evaluated in current phase priority data category for FRAPCON code evaluation purposes. The PIE programs are expected to generate more detailed poolside or hot cell measurements for some 300-600 rods. This data sample is considered large enough to allow statistical evaluation of both data and code analysis results in key fuel performance areas. The currently available (Phase 2) data sample, as described later in Section 3, includes 293 rods. The specific types of parameters involved in the data sample are discussed below.

2.2 Program Data Requirements

As previously stated, fuel rod behavior data and code evaluation requires detailed information on individual fuel rod design, operation, and materials performance parameters. Table 2 shows a simplified breakdown of the physical information corresponding to each of these three primary data categories.

Design data in Table 2 refers to the as built fuel and cladding materials and geometry, including fabrication parameters such as those related to fuel desification tendency or cladding yield strength. Operational data indicates the power history and reactor system conditions to which the rod was subjected. Performance data basically represents the post-irradiation condition of the rod in terms of several key parameters. These parameters establish the extent to which the thermal, mechanical and chemical effects of irradiation have permanently altered the rod from its as-built configuration.

2.3 Data Acquisition Procedures

The implementation of specific data acquisition procedures, as outlined later in this section, had the following prerequisites:

1. Execution of license agreements with EPRI for application of both the FPDB and associated data management software (RIMS),

2. Contact with the data base manager (S. Levy, Inc.) who sought subsequent technical approvals from EPRI and DOE for the UAI program to have FPDB user status,

3. Establishment of the proper external user access procedure for the Quadrex Inc. data center on whose PRIME computer the FPDB is resident,

4. Review of RIMS capabilities and command language to a) access selected FPDB data tables and data fields and

b) activate various data search, ordering, and output functions for the generation of printer and mag tape output, and

5. Review of all available FPDB parameters for identification of desired parameters (field names), and locations (table names).

The results of Item 5 were refined based on trial listing and inspection of the content and structure of the 34 FPDB tables required to meet the data acquisition objectives. Previous attempts to merge information from these many tables onto a fewer number of generic data files were unsuccessful due to missing information in the TRACEABILITY Table, the "root" table for search and merge purposes. An alternate data acquisition method (termed the "table transfer" method) was then developed and successfully applied, as explained in the following paragraphs.

The "table transfer" method essentially involves accessing each data table on an individual basis. The desired data fields (columns) were both printed and written to transportable tape to allow subsequent data search and ordering procedures to be carried out on CYBER equipment. This method permitted processing of the tables without the limitations of remote data center reliability and the inability of non-EPRI contractors to repair or add missing data on the FPDB/RIMS system.

First the rods of primary interest were identified based on the contents of the performance data tables. An ordered list of reactor names and fuel rod serial numbers was obtained, uniquely identifying all rods having measurements available in each of the performance data categories. Using this list, a priority 233 rod data sample was selected based on chosing all rods with profilometry or internal gas data. Design, operational, and performance data files for another 60 rods from DOE-sponsored programs were manually established in the same format as the FPDB "table transfer" results. Existence of clad axial strain data alone did not qualify a rod for joining the sample, but this data was considered for rods already in the sample for other reasons. Fuel axial strain data is not stored in the FPDB for the 293 rods of interest, but this category was manually added for those rods in the sample which had this type of data reported elsewhere. The same procedure was followed for clad surface corrosion data. The availability of clad failure data was not a criterion for priority rod selection because mainly local metalurgical data and verbal observations are stored in the FPDB or documented in the literature. The priority data sample will be further characterized in Section 3.0.

Selection of the 233 rod FPDB data sample allowed RIMS to be used to limit the size (unmanageability) of the unsorted "table transfer" results. The steps taken in this regard can be summarized as follows:

1. Data records (rows of parameters) from reactors other than those 9 (Oyster Creek, Oconee 2, Peach Bottom 2, Dresden 3, Pt. Beach 1, Cal. Cliffs 1, Zion 1, Surry 2 and Maine Yankee) represented by the 233 rods of interest were eliminated*,

2. Certain unnecessary parameters (columns) were also eliminated for each table,

3. Axial power and burnup distribution factors were averaged to yield arrays of 6 values, rather than the 24 specified in the FPDB, and

4. Profilometry data, other than that occurring within 2 inches of planned FRAPCON calculational nodes (1,3,5,7,9, 11 ft), was eliminated.

The disc files generated during the data acquisition phase were merged onto CYBER transportable tapes which were than established on the 176 system at Control Data Corporation's Rockville Cluster Center.

2.4 Data Acquisition Results

The final product of the FPDB data acquisition process was a mag tape containing 30 data files. Nine of these files were eventually eliminated from further consideration since they were found to be unrelated to the 233 rods of interest. The 21 remaining files were manually expanded by adding data for 60 DOE-sponsored rods, as previously stated. Each data file was originally either a duplicate or a subset of one of the FPDB source tables which had previously been identified as containing information from one or more of the basic parameter categories in Table 2. The subset files were the result of "filtering" the FPDB tables as described in Section 2.3. Table 3 summarizes how the basic parameter categories were represented in each of the 30 original tables. It is convenient to further describe the "table transfer" results on the

*The rods from DOE programs were irradiated in an additional 3 reactors (Zorita, Oconee 1, Monticello).

TABLE 3: FPDB TABLE APPLICATION SUMMARY

LOCAL FILE NAME	TABLE FORM NO.	FPDB TBL.NAME	PRIMARY APPLICATION	NOTE
---	010	TRACEABILITY	-----	a
PSINT	125	PELLET_SINT	DESIGN - Pellet densification	
PFAB	130	PELLET_FAB	DESIGN - Pellet density and microstructure	
PCHEM	145	PELLET_CHEM	DESIGN - Pellet impurities and enrichment	
PDIM	150	PELLET_DIM	DESIGN - Pellet geometry	
TCOMP	305	TUBE_COMP	DESIGN - Clad heat treatment and surface roughness	
CDIM	310	CLAD_DIM	DESIGN - Clad geometry	
TMECH	320	TUBE_MECH	DESIGN - Clad properties (alternate heat-treatment)	
---	500	ROD_PARTS	-----	b
RPRESS	505	ROD_PRESS	DESIGN - Rod fill gas pressure and impurities	
RDIM	510	ROD_DIM	DESIGN - Rod, fuel stack, plenum, and spacer lengths	
GIMP	515	GAS_IMP	-----	b
---	530	ROD_HIST	-----	b
PFACTOR	533	PFACTORS	OPERATION (power) - Assy, group, or rod power and distribution vs. irradiation time	
BPROFIL	537	BPROFIL	-----	b,c
TINDEX	620	TRACE_INDEX	PERFORMANCE - Profilometry measurement times and method	
RPROF1	625	ROD_PROFIL1	PERFORMANCE - 1D EOC rod diameter vs. length, linear trace	
RPROF2	626	ROD_PROFIL2	PERFORMANCE - 2D EOC rod diameter vs. length, linear trace	
---	628	ROD_PROFIL4	-----	b
RSPIR	629	ROD_SPIRAL	PERFORMANCE - 2D EOC rod diameter vs. length, spiral trace	
RLEN	630	ROD_LENGTH	PERFORMANCE - EOC rod length vs.time	
---	644	ROD_HERM	-----	b
RGAS	652	ROD_GAS	PERFORMANCE - EOL rod fiss. gas release, gas composition, internal press.	

TABLE 3: FPDB TABLE APPLICATION SUMMARY (cont'd)

LOCAL FILE NAME	TABLE FORM NO.	FPDB TBL.NAME	PRIMARY APPLICATION	NOTE
---	672	ROD_MET	-----	b
---	676	ROD_SEM	-----	b
ADIM	715	ASSY_DIM	DESIGN - Assy hydraulic diameter	
--	844	ASSY_HERM	-----	b
REACTOR	900	REACTOR	OPERATION Cycle startup and shutdown times	
CHIST	901	CORE_HIST	OPERATION (system) - Core coolant conditions vs. irradiation time	
---	915	CORE_CHEM	-----	b

a) some fields applied to development of more complete "trace" table specialized for rod sample of current interest

b) information found to be inapplicable to current analysis due to either (1) parameters being unrelated to priority code and data evaluation parameters or (2) insufficient data content for rod sample

c) enough data for spot checking burnups calculated outside FPDB basis of content and structure of each file as given below.

Appendix A provides a complete listing of the fields (parameter names) transferred to tape from each of the 30 FPDB tables accessed. Reference 4 provides a complete list of the originally present fields in each table.

In FPDB table notation, a field is analogous to a column of data. A record is analogous to a row of data which may be long or short, depending on how many fields are in the row. The record length (number of data fields per row) is constant within each of the source FPDB tables and the transferred tables.

The number of records or rows of information varies greatly among the tables. This fact reflects 2 factors; namely,

1. differences in resolution among the tables; for example, many records may be needed to represent time varying power history for the same rod while only one record per rod is needed to represent the as built fuel diameter or density, and

2. due to lack of "traceability" parameters in some tables, information for rods other than the 233 rod data sample had to be included in the table transfer process to avoid filtering out useful data.

Another feature of the table transfer results in the presence of missing data flags (-101, -201). In most cases, the missing data concerns "non-vital" parameters. In some cases, however, the missing data had to be provided based on documentation review, in order for the rest of the table to be useful. Table "repairs" and other aspects of the data review process are discussed in the next section.

3.0 DATA REVIEW

The data acquisition results described in Section 2 were initially reviewed to insure completeness of information for the 233 rod FPDB data sample. Some of the most important rod indentification, design and operational data for both the FPDB and DOE rods have been consolidated in Table 4. This is the complete list of phase 1 and 2 rods for which fuel performance data is currently being evaluated*. The performance data categories were previously defined in Section 2.3.

The FPDB actually contains more of the performance data of interest than is indicated by the 233 rod data sample. Two procedural "filters" are currently applied by EPRI, however, prior to FPDB access by an external user; namely,

1. Access is only permitted to "qualified" data, i.e., data which has been formally checked and signed off by both the supplier and data base manager, and

2. part of the data (est. 10-30%) is held in "reserve" to allow independent verification of any empirical models that may be derived from the "unreserved" FPDB contents.

Since the FPDB data file records generated by the "table transfer" procedure contained a large amount of extraneous information, and were unordered relative to the rods of interest, it was important to develop a complete "traceability" file by which the rods could be located regardless of which files were being searched. A special UAI program "traceability" table was established based on 3 elements:

1. The rod ID parameters from the FPDB performance data tables,

2. The available TRACEABILITY parameters from FPDB table 010 (see Appendix A), and

3. Special trace parameters which were inserted to replace periodic "missing data flags" (-101, -201) in table 010.

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*Big Rock Point rods (156-168) and a few Maine Yankee rods (149-151) were subsequently dropped from consideration due to unavailability of key information in both the FPDB and documentation sources.

TABLE 4 : ROD IDENTIFICATION SUMMARY FOR CURRENT POWER REACTOR DATA SAMPLE

NROD	RT	AT	RN	AN	FRS	TOD (in)	TID (in)	POD (in)	BP (psia)	FDEN (% TD)	MAX IT (hrs)	MAX ABU (GWD/MTM)
1	PWR	14C	Cal.Cliffs 1	CC1-BT03	CC1-10	.4403	.3881	.3795	465.	93.0	40619	41.7
2	PWR	14C	Cal.Cliffs 1	CC1-BT03	CC1-12	.4400	.3882	.3795	465.	93.0	30145	33.4
3	PWR	14C	Cal.Cliffs 1	CC1-BT03	CC1-24	.4399	.3879	.3795	314.7	95.8	40619	41.2
4	PWR	14C	Cal.Cliffs 1	CC1-BT03	CC1-26	.4402	.3876	.3795	314.7	95.8	40619	41.2
5	PWR	14C	Cal.Cliffs 1	CC1-BT03	CC1-34	.4399	.3881	.3795	465.	96.1	40619	41.2
6	PWR	14C	Cal.Cliffs 1	CC1-BT03	CC1-36	.4399	.3881	.3795	465.	95.8	40619	41.2
7	PWR	14C	Cal.Cliffs 1	CC1-BT03	CC1-45	.4401	.3875	.3795	465.	94.3	40619	46.2
8	PWR	14C	Cal.Cliffs 1	CC1-BT03	CC1-48	.4401	.3881	.3795	465.	94.2	40619	46.2
9	PWR	14C	Cal.Cliffs 1	CC1-BT03	CC1-54	.4400	.3880	.3795	465.	95.3	40619	41.7
10	PWR	14C	Cal.Cliffs 1	CC1-BT03	CC1-60	.4399	.3881	.3795	465.	94.2	30145	33.4
11	PWR	14C	Cal.Cliffs 1	CC1-BT01	CC1-01	.4402	.3880	.3795	464.7	93.0	15443	18.7
12	PWR	14C	Cal.Cliffs 1	CC1-BT01	CC1-43	.4400	.3874	.3795	314.7	94.2	15443	23.2
13	PWR	14C	Cal.Cliffs 1	CC1-BT01	CC1-46	.4397	.3873	.3795	464.7	94.3	15443	21.6
14	PWR	14C	Cal.Cliffs 1	CC1-BT01	CC1-50	.4400	.3884	.3795	464.7	95.4	15443	18.7
15	PWR	14C	Cal.Cliffs 1	CC1-BT02	CC1-05	.4398	.3886	.3795	464.7	93.0	22292	25.8
16	PWR	14C	Cal.Cliffs 1	CC1-BT02	CC1-06	.4402	.3884	.3795	464.7	93.0	22292	23.7
17	PWR	14C	Cal.Cliffs 1	CC1-BT02	CC1-20	.4399	.3879	.3795	314.7	95.8	31582	33.5
18	PWR	14C	Cal.Cliffs 1	CC1-BT02	CC1-32	.4400	.3882	.3795	464.7	95.8	22292	23.7
19	PWR	14C	Cal.Cliffs 1	CC1-BT02	CC1-38	.4397	.3877	.3795	314.7	94.1	31582	38.5
20	PWR	14C	Cal.Cliffs 1	CC1-BT02	CC1-41	.4400	.3880	.3795	464.7	93.9	31582	38.6
21	PWR	14C	Cal.Cliffs 1	CC1-BT02	CC1-47	.4403	.3881	.3795	464.7	94.2	22292	29.1
22	PWR	14C	Cal.Cliffs 1	CC1-BT02	CC1-51	.4400	.3884	.3795	464.7	95.6	22292	25.8
23	PWR	14C	Cal.Cliffs 1	CC1-BT02	CC1-52	.4401	.3881	.3795	464.7	95.6	31582	34.0
24	PWR	14C	Cal.Cliffs 1	CC1-BT02	CC1-58	.4400	.3880	.3795	464.7	94.1	22292	23.7
25	BWR	7G	Dresden 3	DDØ693	KJ-0723	.5630	.4990	.4870	15.1	94.0	23809	14.3
26	BWR	7G	Dresden 3	DDØ021	KD-0451	.5630	.4990	.4870	15.1	94.0	23809	14.4
27	BWR	7G	Dresden 3	DDØ710	KB-5239	.5630	.4990	.4870	15.1	94.0	23809	11.9
28	BWR	7G	Dresden 3	DDØ710	KB-5249	.5630	.4990	.4870	15.1	94.0	23809	12.0
29	PWR	14C	M. Yankee	1047	HBU-169	.4400	.3880	.3795	15.1	93.0	16751	18.1
30	PWR	14C	M. Yankee	1047	HBU-198	.4400	.3880	.3795	15.1	93.0	16751	16.4
31	PWR	14C	M. Yankee	1047	HBV-002	.4000	.3880	.3795	15.1	93.0	16751	18.3
32	PWR	14C	M. Yankee	1047	HBV-007	.4400	.3880	.3795	15.1	93.0	16751	17.2
33	PWR	14C	M. Yankee	1047	HBV-067	.4400	.3880	.3795	15.1	93.0	16751	18.1
34	PWR	14C	M. Yankee	2042	JBP-003	.4400	.3880	.3795	15.1	93.0	11967	13.6
35	PWR	14C	M. Yankee	2042	JBP-004	.4400	.3880	.3795	15.1	93.0	11967	13.2
36	PWR	14C	M. Yankee	2042	JBP-005	.4400	.3880	.3795	15.1	93.0	11967	13.2
37	PWR	14C	M. Yankee	2042	JBP-027	.4400	.3880	.3795	15.1	93.0	11967	12.8
38	PWR	14C	M. Yankee	2042	JBP-122	.4400	.3880	.3795	15.1	93.0	11967	13.6
39	PWR	15B	Oconee 2	2B15	50ØC2	.4295	.3775	.3699	374.7	92.5	17790	24.0
40	PWR	15B	Oconee 2	2B15	51ØC2	.4295	.3775	.3699	374.7	92.5	17790	24.0
41	PWR	15B	Oconee 2	2B15	75003E	.4294	.3767	.3700	374.7	93.0	17790	24.0
42	PWR	15B	Oconee 2	2B15	75006E	.4294	.3772	.3699	374.7	92.5	17790	24.0
43	PWR	15B	Oconee 2	2B15	75007E	.4294	.3772	.3700	374.7	93.0	17790	24.0
44	PWR	15B	Oconee 2	2B15	75010E	.4290	.3767	.3699	374.7	92.5	17790	24.0
45	PWR	15B	Oconee 2	2B15	75011E	.4290	.3767	.3700	374.7	93.0	17790	24.0
46	PWR	15B	Oconee 2	2B15	75012E	.4294	.3767	.3698	374.7	92.5	17790	24.0
47	PWR	15B	Oconee 2	2B15	75015E	.4290	.3767	.3700	374.7	93.0	17790	24.0
48	PWR	15B	Oconee 2	2B15	75018E	.4294	.3772	.3698	374.7	92.5	17790	24.0

CONTINUED..........

TABLE 4 : ROD IDENTIFICATION SUMMARY FOR CURRENT POWER REACTOR DATA SAMPLE (Continued)

NROD	RT	AT	RN	AN	FRS	TOD (in)	TID (in)	POD (in)	BP (psia)	FDEN (% TD)	MAX IT (hrs)	MAX ABU (GWD/MTM)
49	PWR	15B	Oconee 2	2B15	75019E	.4295	.3775	.3700	374.7	93.0	17790	24.0
50	PWR	15B	Oconee 2	2B15	75023E	.4294	.3767	.3700	374.7	93.0	17790	24.0
51	PWR	15B	Oconee 2	2B15	75024E	.4294	.3767	.3698	374.7	92.5	17790	24.0
52	PWR	15B	Oconee 2	2B40	13897E	.4295	.3775	.3699	374.7	92.5	17790	23.7
53	PWR	15B	Oconee 2	2B40	13960E	.4295	.3775	.3699	374.7	92.5	17790	25.3
54	PWR	15B	Oconee 2	2B40	57ØC2	.4295	.3775	.3699	374.7	92.5	17790	24.0
55	PWR	15B	Oconee 2	2B40	75025E	.4294	.3767	.3700	374.7	93.0	17790	23.7
56	PWR	15B	Oconee 2	2B40	75026E	.4294	.3767	.3699	374.7	92.5	17790	24.0
57	PWR	15B	Oconee 2	2B40	75028E	.4290	.3767	.3699	374.7	92.5	17790	25.0
58	PWR	15B	Oconee 2	2B40	75029E	.4294	.3772	.3700	374.7	93.0	17790	23.6
59	PWR	15B	Oconee 2	2B40	75030E	.4294	.3772	.3698	374.7	92.5	17790	24.0
60	PWR	15B	Oconee 2	2B40	75032E	.4294	.3772	.3698	374.7	92.5	17790	24.0
61	PWR	15B	Oconee 2	2B40	75033E	.4294	.3772	.3700	374.7	93.0	17790	23.6
62	PWR	15B	Oconee 2	2B40	75037E	.4290	.3767	.3700	374.7	93.0	17790	24.0
63	PWR	15B	Oconee 2	2B40	75038E	.4294	.3767	.3699	374.7	92.5	17790	24.2
64	PWR	15B	Oconee 2	2B40	75040E	.4290	.3767	.3699	374.7	92.5	17790	24.0
65	PWR	15B	Oconee 2	2B40	75041E	.4295	.3775	.3700	374.7	93.0	17790	23.2
66	PWR	15B	Oconee 2	2B40	75045E	.4295	.3775	.3700	374.7	93.0	17790	24.0
67	PWR	15B	Oconee 2	2B40	75046E	.4290	.3767	.3698	374.7	92.5	17790	24.0
68	BWR	8E	Oys. Crk.	ØC4070	YB2-00062	.5008	.4295	.4200	14.7	93.7	23951	18.0
69	BWR	8E	Oys. Crk.	ØC4070	YB3-00222	.5012	.4295	.4200	14.7	93.6	23951	18.3
70	BWR	8E	Oys. Crk.	ØC4070	YB3-00768	.5016	.4295	.4200	14.7	93.6	23951	19.4
71	BWR	8E	Oys. Crk.	ØC4070	YB4-00341	.5014	.4295	.4200	14.7	93.7	23951	17.9
72	BWR	8E	Oys. Crk.	ØC4070	YB4-00350	.5014	.4295	.4200	14.7	93.7	23951	17.2
73	BWR	8E	Oys. Crk.	ØC4070	YB4-00359	.4999	.4295	.4200	14.7	93.7	23951	18.8
74	BWR	8E	Oys. Crk.	ØC4070	YD1-00153	.5008	.4295	.4200	14.7	93.5	23951	16.3
75	BWR	8E	Oys. Crk.	ØC6054	ØG2-00529	.5027	.4295	.4195	14.7	93.7	9663	8.6
76	BWR	8E	Oys. Crk.	ØC6059	ØG2-00537	.5031	.4286	.4196	14.7	93.8	9663	8.1
77	BWR	8E	Oys. Crk.	ØC6059	ØG2-00541	.5027	.4295	.4195	14.7	93.7	9663	8.6
78	BWR	8E	Oys. Crk.	ØC6054	ØG3-01081	.5024	.4295	.4196	14.7	93.6	9663	9.2
79	BWR	8E	Oys. Crk.	ØC6059	ØG3-01103	.5029	.4295	.4196	14.7	93.6	9663	9.8
80	BWR	8E	Oys. Crk.	ØC6054	ØG4-03684	.5025	.4295	.4194	14.7	94.0	9663	9.2
81	BWR	8E	Oys. Crk.	ØC6059	ØG4-03694	.5019	.4295	.4194	14.7	94.0	9663	9.2
82	BWR	8E	Oys. Crk.	ØC6059	ØG4-03697	.5017	.4295	.4194	14.7	94.0	9663	8.7
83	BWR	8E	Oys. Crk.	ØC6054	ØG2-00521	.5018	.4294	.4195	14.7	93.7	9663	8.1
84	BWR	7E	Oys. Crk.	UD000A	CB20001	.5700	.4990	.4880	14.7	93.5	33028	23.2
85	BWR	7E	Oys. Crk.	UD000A	CB20002	.5700	.4990	.4880	14.7	93.5	33028	23.2
86	BWR	7E	Oys. Crk.	UD000A	CB40002	.5700	.4990	.4880	14.7	93.5	33028	23.4
87	BWR	7E	Oys. Crk.	UD000A	CB40004	.5700	.4990	.4880	14.7	93.5	33028	26.4
88	BWR	7E	Oys. Crk.	UD000A	CB40005	.5700	.4990	.4880	14.7	93.5	33028	23.4
89	BWR	7E	Oys. Crk.	UD000A	CB40007	.5700	.4990	.4880	14.7	93.5	33028	22.5
90	BWR	7E	Oys. Crk.	UD000A	CB40009	.5700	.4990	.4880	14.7	93.5	33028	25.3
91	BWR	7E	Oys. Crk.	UD000A	CB40011	.5700	.4990	.4880	14.7	93.5	33028	23.2
92	BWR	7E	Oys. Crk.	UD000A	CB40015	.5700	.4990	.4880	14.7	93.5	33028	23.1
93	BWR	7E	Oys. Crk.	UD000A	CB40016	.5700	.4990	.4880	14.7	93.5	33028	23.4
94	BWR	7E	Oys. Crk.	UD000A	CB40017	.5700	.4990	.4880	14.7	93.5	33028	23.3
95	BWR	7E	Oys. Crk.	UD000A	CB40018	.5700	.4990	.4880	14.7	93.5	33028	26.3
96	BWR	7E	Oys. Crk.	UD000A	CB40019	.5700	.4990	.4880	14.7	93.5	33028	25.3

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TABLE 4 : ROD IDENTIFICATION SUMMARY FOR CURRENT POWER REACTOR DATA SAMPLE (Continued)

NROD	RT	AT	RN	AN	FRS	TOD (in)	TID (in)	POD (in)	BP (psia)	FDEN (% TD)	MAX IT (hrs)	MAX ABU (GWD/MTM)
97	BWR	7E	Oys. Crk.	UD000A	CB40020	.5700	.4990	.4880	14.7	93.5	33028	24.8
98	BWR	7E	Oys. Crk.	UD000A	CB40021	.5700	.4990	.4880	14.7	93.5	33028	25.3
99	BWR	7E	Oys. Crk.	UD000A	CC20001	.5700	.4790	.4680	14.7	93.5	33028	24.9
100	BWR	7E	Oys. Crk.	UD000A	CC20002	.5700	.4790	.4680	14.7	93.5	33028	24.9
101	BWR	7E	Oys. Crk.	UD000A	CC20003	.5700	.4790	.4680	14.7	93.5	33028	25.9
102	BWR	7E	Oys. Crk.	UD000A	CC30001	.5700	.4990	.4680	14.7	93.5	33028	25.2
103	BWR	7E	Oys. Crk.	UD000A	CC30002	.5700	.4790	.4680	14.7	93.5	33028	27.0
104	BWR	7E	Oys. Crk.	UD000A	CC30003	.5700	.4790	.4680	14.7	93.5	33028	27.9
105	BWR	7E	Oys. Crk.	UD000A	CC30009	.5700	.4790	.4680	14.7	93.5	33028	26.4
106	BWR	7E	Oys. Crk.	UD000A	CC30016	.5700	.4790	.4680	14.7	93.5	33028	27.9
107	BWR	7E	Oys. Crk.	UD000A	CC30023	.5700	.4790	.4680	14.7	93.5	33028	26.4
108	BWR	7E	Oys. Crk.	UD000A	CC40001	.5700	.4790	.4680	14.7	93.5	33028	27.8
109	BWR	7E	Oys. Crk.	UD000A	CC40002	.5700	.4790	.4680	14.7	93.5	33028	26.5
110	BWR	7E	Oys. Crk.	UD000A	CC40003	.5700	.4790	.4680	14.7	93.5	33028	27.8
111	BWR	7E	Oys. Crk.	UD000A	CC40004	.5700	.4790	.4680	14.7	93.5	33028	26.5
112	BWR	7E	Oys. Crk.	UD000A	CE10001	.5700	.4990	.4880	14.7	93.5	33025	23.2
113	BWR	7E	Oys. Crk.	UD000A	CE10002	.5700	.4990	.4880	14.7	93.5	33028	23.2
114	BWR	8G	Pch. Bot 2	LJLTA2	DJD0245	.4818	.4184	.4096	19.7	95.6	27780	26.9
115	BWR	8G	Pch. Bot 2	LJLTA2	DJD0277	.4818	.4184	.4096	19.7	95.6	27780	26.9
116	PWR	14W	Pt. Beach 1	D-14	A1-PB1	.4220	.3736	.3660	385.0	93.7	20387	15.6
117	PWR	14W	Pt. Beach 1	D-14	A9-PB1	.4220	.3736	.3659	385.0	93.7	20387	19.4
118	PWR	14W	Pt. Beach 1	D-14	B11-PB1	.4220	.3736	.3659	385.0	93.7	20387	20.9
119	PWR	14W	Pt. Beach 1	D-14	E3-PB1	.4220	.3736	.3660	385.0	93.8	20387	20.6
120	PWR	14W	Pt. Beach 1	D-14	K6-PB1	.4220	.3736	.3660	385.0	93.7	20387	25.1
121	PWR	15W	Zion 1	C64-Z1	601-Z1	.4221	.3735	.3660	464.7	94.2	36371	38.2
122	PWR	15W	Zion 1	C64-Z1	614-Z1	.4221	.3735	.3660	464.7	94.2	36371	38.3
123	PWR	15W	Zion 1	C64-Z1	650-Z1	.4223	.3739	.3660	464.7	94.2	36371	41.4
124	BWR	8E	Oys. Crk.	ØC6054	ØG2-00523	.5021	.4296	.4196	14.7	93.8	9663	9.2
125	BWR	8E	Oys. Crk.	ØC6054	ØG2-00530	.5027	.4295	.4195	14.7	93.7	9663	8.6
126	BWR	8E	Oys. Crk.	ØC6059	ØG2-00542	.5031	.4295	.4196	14.7	93.8	9663	8.6
127	BWR	8E	Oys. Crk.	ØC6054	ØG3-01085	.5029	.4295	.4196	14.7	93.6	9663	9.8
128	BWR	8E	Oys. Crk.	ØC6054	ØG4-03682	.5026	.4295	.4200	14.7	93.8	9663	8.5
129	BWR	8E	Oys. Crk.	ØC6059	ØG4-03696	.5021	.4295	.4194	14.7	94.0	9663	9.2
130	BWR	8E	Oys. Crk.	ØC6059	ØG2-00538	.5031	.4289	.4196	14.7	93.8	9663	9.2
131	BWR	8E	Oys. Crk.	ØC6059	ØG3-01102	.5024	.4295	.4196	14.7	93.6	9663	9.2
132	BWR	8E	Oys. Crk.	ØC6059	ØG4-03695	.5028	.4295	.4194	14.7	94.0	9663	8.5
133	BWR	8E	Oys. Crk.	ØC4070	YB2-00043	.5007	.4295	.4200	14.7	93.7	23951	17.6
134	BWR	8E	Oys. Crk.	ØC4070	YB2-00044	.5006	.4295	.4200	14.7	93.7	23951	16.3
135	BWR	8E	Oys. Crk.	ØC4070	YB3-00218	.5017	.4295	.4200	14.7	93.6	23951	19.9
136	BWR	8E	Oys. Crk.	ØC4070	YB4-00337	.5012	.4295	.4200	14.7	93.8	23951	16.7
137	BWR	8E	Oys. Crk.	ØC4070	YB4-00347	.5012	.4295	.4200	14.7	93.7	23951	17.0
138	BWR	8E	Oys. Crk.	ØC4070	YB4-00348	.5012	.4295	.4200	14.7	93.7	23951	17.7
139	BWR	7G	Dresden 3	DDØ706	KE-2225	.5630	.4990	.4870	15.1	94.0	23810	11.4
140	BWR	7G	Dresden 3	DDØ191	KC-4411	.5630	.4990	.4870	15.1	94.0	23810	14.5
141	BWR	7G	Dresden 3	DDØ706	KG-2119	.5630	.4990	.4870	15.1	94.0	23810	11.0
142	PWR	14C	M. Yankee	2069	JCN-182	.4400	.3880	.3795	15.1	93.0	11967	12.6
143	PWR	14C	M. Yankee	2069	JBY-157	.4400	.3880	.3795	15.1	93.0	11967	12.9
144	PWR	14C	M. Yankee	2069	JBY-142	.4400	.3880	.3795	15.1	93.0	11967	12.3
145	PWR	14C	M. Yankee	4231	KCA-125	.4400	.3880	.3795	15.1	93.0	16751	10.6

CONTINUED...........

TABLE 4 : ROD IDENTIFICATION SUMMARY FOR CURRENT POWER REACTOR DATA SAMPLE (Continued)

NROD	RT	AT	RN	AN	FRS	TOD (in)	TID (in)	POD (in)	BP (psia)	FDEN (% TD)	MAX IT (hrs)	MAX ABU (GWD/MTM)
146	PWR	14C	M. Yankee	2069	JCN-199	.4400	.3880	.3795	15.1	93.0	11967	12.8
147	PWR	14C	M. Yankee	2069	JCN-196	.4400	.3880	.3795	15.1	93.0	11967	12.8
148	PWR	14C	M. Yankee	2069	JBY-Q97	.4400	.3880	.3795	15.1	93.0	11967	13.3
149	PWR	14C	M. Yankee	4231	KCA-019	.4400	.3380	.3795	15.1	93.0	-	-
150	PWR	14C	M. Yankee	4231	KCA-109	.4400	.3380	.3795	15.1	93.0	-	-
151	PWR	14C	M. Yankee	4231	KCA-185	.4400	.3880	.3795	15.1	93.0	-	-
152	BWR	8G	P. Bottom 2	LJLTA3	DJD0163	.4818	.4184	.4096	19.7	95.5	27780	27.3
153	BWR	8G	P. Bottom 2	LJLTA3	DJD0191	.4818	.4184	.4096	19.7	95.5	27780	27.3
154	BWR	8G	P. Bottom 2	LJLTA3	DJD0309	.4816	.4184	.4096	19.7	95.5	27780	27.8
155	BWR	8G	P. Bottom 2	LJLTA3	DJD0306	.4820	.4184	.4086	19.7	95.5	27780	27.8
156	BWR	11E	Big Rock Pt.	G02-BRP	JJ400002	-	-	-	-	-	-	-
157	BWR	11E	Big Rock Pt.	G02-BRP	JK400001	-	-	-	-	-	-	-
158	BWR	11E	Big Rock Pt.	G01-BR	JM400008	-	-	-	-	-	-	-
159	BWR	11E	Big Rock Pt.	D71-BRP	AB400003	-	-	-	-	-	-	-
160	BWR	11E	Big Rock Pt.	D71-BRP	AB300001	-	-	-	-	-	-	-
161	BWR	11E	Big Rock Pt.	D71-BRP	AB200001	-	-	-	-	-	-	-
162	BWR	11E	Big Rock Pt.	D71-BR	AB100001	-	-	-	-	-	-	-
163	BWR	11E	Big Rock Pt.	D71-BR	AB400001	-	-	-	-	-	-	-
164	BWR	11E	Big Rock Pt.	G21-BRP	PT300002	-	-	-	-	-	-	-
165	BWR	11E	Big Rock Pt.	G21-BRP	PS300002	-	-	-	-	-	-	-
166	BWR	11E	Big Rock Pt.	D72-BRP	XA-30303	-	-	-	-	-	-	-
167	BWR	11E	Big Rock Pt.	G02-BRP	XB-30206	-	-	-	-	-	-	-
168	BWR	11E	Big Rock P.t	G02-BRP	XB-30307	-	-	-	-	-	-	-
169	PWR	14C	Cal Cliffs 1	CC1-BT03	CC1-39	.4399	.3875	.3795	314.7	94.2	30145	37.7
170	PWR	14C	Cal Cliffs 1	CC1-BT03	CC1-42	.4402	.3382	.3795	464.7	94.0	30145	37.5
171	PWR	14C	Cal Cliffs 1	CC1-BT03	CC1-53	.4402	.3878	.3795	464.7	95.4	30145	33.3
172	PWR	14C	Cal Cliffs 1	CC1-BT03	CC1-11	.4403	.3883	.3795	464.7	93.0	30145	33.3
173	PWR	14C	Cal Cliffs 1	CC1-BT03	CC1-23	.4398	.3876	.3795	314.7	95.8	40619	41.3
174	PWR	14C	Cal Cliffs 1	CC1-BT03	CC1-33	.4403	.3883	.3795	464.7	95.8	40619	41.3
175	PWR	14C	Cal Cliffs 1	CC1-BT03	CC1-09	.4401	.3883	.3795	464.7	93.0	40619	41.7
176	PWR	14C	Cal Cliffs 1	CC1-BT02	CC1-19	.4401	.3883	.3795	314.7	95.8	22292	23.7
177	PWR	14C	Cal Cliffs 1	CC1-BT03	CC1-25	.4398	.3880	.3795	314.7	95.8	40619	41.2
178	PWR	14C	Cal Cliffs 1	CC1-BT01	CC1-03	.4398	.3878	.3795	464.7	93.0	15443	21.1
179	PWR	14C	Cal Cliffs 1	CC1-BT02	CC1-31	.4400	.3882	.3795	464.7	95.8	31582	34.0
180	PWR	14C	Cal Cliffs 1	CC1-BT03	CC1-35	.4400	.3882	.3795	464.7	95.8	40619	41.2
181	PWR	14C	Cal Cliffs 1	CC1-BT01	CC1-37	.4399	.3881	.3975	314.7	94.2	15443	22.9
182	PWR	14C	Cal Cliffs 1	CC1-BT01	CC1-40	.4402	.3882	.3795	464.7	94.0	15443	23.0
183	PWR	14C	Cal Cliffs 1	CC1-BT02	CC1-44	.4399	.3875	.3795	314.7	94.1	31582	37.5
184	PWR	14C	Cal Cliffs 1	CC1-BT01	CC1-55	.4401	.3879	.3795	464.7	94.1	15443	21.0
185	PWR	14C	Cal Cliffs 1	CC1-BT03	CC1-59	.44U3	.3881	.3795	464.7	94.2	40619	41.9
186	PWR	15B	Øconee 2	2B40	75042E	.4294	.3772	.3698	374.7	92.5	17790	23.5
187	PWR	15B	Øconee 2	2B40	75036E	.4294	.3767	.3699	374.7	92.5	17790	24.0
188	PWR	15B	Øconee 2	2B40	75034E	.4290	.3767	.3699	374.7	92.5	17790	24.5
189	PWR	15B	Øconee 2	2B40	75043E	.4295	.3775	.3700	374.7	93.0	17790	22.9
190	PWR	15B	Øconee 2	2B40	75047E	.4294	.3767	.3700	374.7	93.0	17790	24.2
191	PWR	15B	Øconee 2	2B40	75039E	.4290	.3767	.3700	374.7	93.0	17790	24.0
192	PWR	15B	Øconee 2	2B40	13931E	.4295	.3775	.3699	374.7	92.5	17790	23.9
193	PWR	15B	Øconee 2	2B15	490C2	.4295	.3775	.3699	374.7	92.5	17790	24.0
194	PWR	15B	Øconee 2	2B40	540C2	.4295	.3775	.3699	374.7	92.5	17790	24.0

CONTINUED........

TABLE 4 : ROD IDENTIFICATION SUMMARY FOR CURRENT POWER REACTOR DATA SAMPLE (Continued)

NROD	RT	AT	RN	AN	FRS	TOD (in)	TID (in)	POD (in)	BP (psia)	FDEN (% TD)	MAX IT (hrs)	MAX ABU (GWD/MTM)
195	PWR	15B	Øconee 2	2B40	580C2	.4295	.3775	.3699	374.7	92.5	17790	24.0
196	PWR	15B	Øconee 2	2B15	75001E	.4294	.3767	.3700	374.7	93.0	17790	24.0
197	PWR	15B	Øconee 2	2B15	75002E	.4294	.3767	.3698	374.7	92.5	17790	24.0
198	PWR	15B	Øconee 2	2B15	75005E	.4294	.3772	.3700	374.7	93.0	17790	24.0
199	PWR	15B	Øconee 2	2B15	75008E	.4294	.3772	.3698	374.7	92.5	17790	24.0
200	PWR	15B	Øconee 2	2B15	75009E	.4294	.3772	.3700	374.7	93.0	17790	24.0
201	PWR	15B	Øconee 2	2B15	75013E	.4290	.3767	.3700	374.7	93.0	17790	24.0
202	PWR	15B	Øconee 2	2B15	75014E	.4294	.3767	.3698	374.7	92.5	17790	24.0
203	PWR	15B	Øconee 2	2B15	75016E	.4290	.3767	.3698	374.7	92.5	17790	24.0
204	PWR	15B	Øconee 2	2B15	75017E	.4295	.3775	.3700	374.7	93.0	17790	24.0
205	PWR	15B	Øconee 2	2B15	75020E	.4294	.3772	.3699	374.7	92.5	17790	24.0
206	PWR	15B	Øconee 2	2B15	75021E	.4295	.3775	.3700	374.7	93.0	17790	24.0
207	PWR	15B	Øconee 2	2B15	75022E	.4290	.3767	.3698	374.7	92.5	17790	24.0
208	PWR	15B	Øconee 2	2B40	75027E	.4294	.3767	.3700	374.7	93.0	17790	24.0
209	PWR	15B	Øconee 2	2B40	75031E	.4294	.3772	.3700	374.7	93.0	17790	24.0
210	PWR	15B	Øconee 2	2B40	75035E	.4290	.3767	.3700	374.7	93.0	17790	24.0
211	PWR	15B	Øconee 2	2B40	75044E	.4294	.3772	.3698	374.7	92.5	17790	24.0
212	PWR	15B	Øconee 2	2B40	75048E	.4294	.3767	.3698	374.7	92.5	17790	24.6
213	PWR	15B	Øconee 2	2B15	52ØC2	.4925	.3775	.3699	374.7	92.5	17790	24.0
214	PWR	15B	Øconne 2	2B15	75004E	.4290	.3767	.3699	374.7	92.5	17790	24.0
215	PWR	15W	Pt Beach 1	D-40	045-PB1	.4220	.3736	.3660	385.	93.7	20388	29.4
216	PWR	15W	Pt Beach 1	D-40	037-PB1	.4220	.3736	.3659	385.	93.7	20388	29.4
217	PWR	15W	Zion 1	C63-Z1	622-Z1	.4220	.3730	.3660	465.	94.2	36371	41.2
218	PWR	15W	Zion 1	C63-Z1	646-Z1	.4225	.3735	.3660	465.	94.2	36371	39.8
219	PWR	15W	Zion 1	C63-Z1	654-Z1	.4223	.3738	.3660	465.	94.2	36371	40.2
220	PWR	15W	Zion 1	C63-Z1	663-Z1	.4224	.3736	.3660	465.	94.2	36371	38.2
221	PWR	17W	Surry 2	RD-2	500-S2	.3740	.3290	.3224	514.7	94.1	24796	29.6
222	PWR	17W	Surry 2	RD-2	501-S2	.3740	.3290	.3224	514.7	94.1	24796	30.5
223	PWR	17W	Surry 2	RD-2	502-S2	.3742	.3290	.3224	514.7	94.1	13306	14.6
224	PWR	17W	Surry 2	RD-2	503-S2	.3738	.3290	.3224	514.7	94.1	13306	14.7
225	PWR	17W	Surry 2	RD-2	505-S2	.3737	.3290	.3224	514.7	94.1	13306	14.6
226	PWR	17W	Surry 2	RD-2	506-S2	.3740	.3290	.3224	514.7	94.1	24796	30.3
227	PWR	17W	Surry 2	RD-2	508-S2	.3743	.3290	.3224	514.7	94.1	24796	30.1
228	PWR	17W	Surry 2	RD-2	509-S2	.3738	.3290	.3224	514.7	94.1	24796	30.5
229	PWR	17W	Surry 2	RD-2	510-S2	.3741	.3290	.3224	514.7	94.1	13306	14.6
230	PWR	17W	Surry 2	RD-2	511-S2	.3739	.3290	.3224	514.7	94.1	24796	30.4
231	PWR	17W	Surry 2	RD-2	512-S2	.3734	.3290	.3224	514.7	94.1	24796	29.6
232	PWR	17W	Surry 2	RD-2	514-S2	.3741	.3290	.3224	514.7	94.1	13306	15.0
233	PWR	15W	Zorita	E-22X	293	.4225	.3727	.3673	15.	94.6	32012	49.1
234	PWR	15W	Zorita	E-22X	383	.4227	.3727	.3672	15.	94.2	32012	55.0
235	PWR	15W	Zorita	E-22X	385	.4222	.3724	.3672	500.	94.2	32012	55.0
236	PWR	15W	Zorita	E-22X	313	.4232	.3734	.3669	500.	93.1	32012	39.0
237	PWR	15W	Zorita	E-22X	314	.4232	.3734	.3669	500.	93.1	32012	38.7
238	PWR	15W	Zorita	E-22X	316	.4238	.3740	.3669	500.	93.1	32012	38.9
239	PWR	15W	Zorita	E-22X	318	.4239	.3741	.3669	500.	93.1	32012	39.0
240	PWR	15W	Zorita	E-22X	387	.4228	.3730	.3669	15.	93.1	32012	39.4
241	PWR	15W	Zorita	E-22X	388	.4233	.3735	.3669	15.	93.1	32012	38.6
242	PWR	15W	Zorita	E-22X	294	.4225	.3737	.3673	500.	94.6	32012	49.2

TABLE 4 : ROD IDENTIFICATION SUMMARY FOR CURRENT POWER REACTOR DATA SAMPLE (Continued)

NROD	RT	AT	RN	AN	FRS	TOD (in)	TID (in)	POD (in)	BP (psia)	FDEN (% TD)	MAX IT (hrs)	MAX ABU (GWD/MTM)
243	PWR	15W	Zorita	E-22X	379	.4240	.3734	.3672	15	94.2	32012	55.5
244	PWR	15W	Zorita	E-22X	384	.4225	.3733	.3669	15	94.8	32012	54.1
245	PWR	15W	Zorita	E-22X	386	.4230	.3732	.3669	500	94.8	32012	54.1
246	PWR	15W	Zorita	E-23X	330	.4235	.3737	.3668	15	93.8	32012	57.0
247	PWR	15W	Zorita	E-23X	332	.4229	.3731	.3668	500	93.8	32012	57.4
248	PWR	15W	Zorita	E-23X	362	.4238	.3740	.3669	15	93.1	32012	36.6
249	PWR	15W	Zorita	E-23X	363	.4234	.3736	.3669	500.	93.1	32012	39.4
250	PWR	15W	Zorita	E-23X	364	.4230	.3732	.3669	15.	93.1	32012	38.7
251	PWR	15W	Zorita	E-23X	370	.4231	.3733	.3669	15.	93.1	32012	35.8
252	PWR	15W	Zorita	E-23X	371	.4235	.3737	.3669	15.	93.1	32012	35.8
253	PWR	15W	Zorita	E-23X	230	.4234	.3736	.3671	15.	94.1	32012	50.5
254	PWR	15W	Zorita	E-23X	334	.4227	.3729	.3669	15.	94.8	32012	53.6
255	PWR	15W	Zorita	E-23X	336	.4232	.3734	.3669	500	94.8	32012	54.0
256	PWR	15W	Zorita	E-23X	344	.4238	.3740	.3672	500	94.2	32012	54.0
257	PWR	15B	Oconee 1	1D13	08623	.4300	.3770	.3685	465	95.5	27568	39.7
258	PWR	15B	Oconee 1	1D13	08634	.4300	.3770	.3685	465	95.5	27568	38.8
259	PWR	15B	Oconee 1	1D13	08639	.4300	.3770	.3685	465	95.5	27568	39.1
260	PWR	15B	Oconee 1	1D13	08640	.4300	.3770	.3685	465	95.5	27568	39.7
261	PWR	15B	Oconee 1	1D13	08646	.4300	.3770	.3685	465	95.5	27568	39.1
262	PWR	15B	Oconee 1	1D13	08647	.4300	.3770	.3685	465	95.5	27568	39.1
263	PWR	15B	Oconee 1	1D13	08663	.4300	.3770	.3685	465	95.5	27568	38.8
264	PWR	15B	Oconee 1	1D13	08672	.4300	.3770	.3685	465	95.5	27568	38.8
265	PWR	15B	Oconee 1	1D13	08708	.4300	.3770	.3685	465	95.5	27568	39.6
266	PWR	15B	Oconee 1	1D13	08734	.4300	.3770	.3685	465	95.5	27568	39.1
267	PWR	15B	Oconee 1	1D13	08747	.4300	.3770	.3685	465	95.5	27568	39.5
268	PWR	15B	Oconee 1	1D13	08751	.4300	.3770	.3685	465	95.5	27568	38.8
269	PWR	15B	Oconee 1	1D13	09566	.4300	.3770	.3685	465	95.5	27568	39.6
270	PWR	15B	Oconee 1	1D13	09603	.4300	.3770	.3685	465	95.5	27568	38.8
271	PWR	15B	Oconee 1	1D13	09607	.4300	.3770	.3685	465	95.5	27568	38.8
272	PWR	15B	Oconee 1	1D13	09644	.4300	.3770	.3685	465	95.5	27568	39.5
273	PWR	15B	Oconee 1	1D54	18221	.4300	.3770	.3679	465	96.0	20282	32.1
274	PWR	15B	Oconee 1	1D54	15547	.4300	.3770	.3679	465.	96.0	20282	31.5
275	PWR	15B	Oconee 1	1D54	15566	.4300	.3770	.3679	465.	96.0	20282	31.6
276	PWR	15B	Oconee 1	1D54	17272	.4300	.3770	.3679	465.	96.0	20282	31.6
277	PWR	15B	Oconee 1	1D54	17273	.4300	.3770	.3679	465.	96.0	20282	32.6
278	PWR	15B	Oconee 1	1D54	17297	.4300	.3770	.3679	465.	96.0	20282	32.6
279	BWR	8G	Monticello	MTB099	BNC0905	.4956	.4276	.4186	15.	95.0	52699	43.0
280	BWR	8G	Monticello	MTB099	BNH0559	.4922	.4242	.4152	15.	95.0	52699	35.1
281	BWR	8G	Monticello	MTB099	BND1966	.4931	.4251	.4161	15.	95.0	52699	33.9
282	BWR	8G	Monticello	MTB099	BNC0980	.4943	.4263	.4173	15.	95.0	52699	43.0
283	BWR	8G	Monticello	MTB099	BNB0439	.4940	.4260	.4170	15.	95.0	52699	43.6
284	BWR	8G	Monticello	MTB099	BNB0418	.4936	.4256	.4166	15.	95.0	52699	43.6
285	BWR	8G	Monticello	MTB099	BNB0454	.4949	.4269	.4179	15.	95.0	52699	43.6
286	BWR	8G	Monticello	MTB099	BNB0407	.4936	.4256	.4166	15.	95.0	52699	43.6
287	BWR	8G	Monticello	MTB099	BNA0208	.4960	.4280	.4190	15.	95.0	52699	43.6
288	BWR	8G	Monticello	MTB099	BNC0976	.4948	.4268	.4178	15.	95.0	52699	41.1
289	BWR	8G	Monticello	MTB048	BND3675	.4942	.4262	.4172	15.	95.0	52699	30.9
290	BWR	8G	Monticello	MTB048	BNH0363	.4942	.4262	.4172	15.	95.0	52699	32.0

TABLE 4 : ROD IDENTIFICATION SUMMARY FOR CURRENT POWER REACTOR DATA SAMPLE (Continued)

NROD	RT	AT	RN	AN	FRS	TOD (in)	TID (in)	POD (in)	BP (psia)	FDEN (% TD)	MAX IT (hrs)	MAX ABU (GWD/MTM)
291	BWR	8G	Monticello	MTB048	BNA0114	.4942	.4262	.4172	15.	95.0	52699	39.9
292	BWR	8G	Monticello	MTB048	BNB0119	.4942	.4262	.4186	15.	95.0	52699	37.3
293	BWR	8G	Monticello	MTB048	BNE0481	.4942	.4262	.4172	15.	95.0	52699	38.3

NROD: ID No. for Phase 1 (1-123) and Phase 2 (124-293) rods

RT: Reactor Name

AT: Assembly type (no. indicates rod array size; letter indicates vendor)

AN: Assembly Name

FRS: Fuel Rod Serial No.

TOD: Clad O.D.

TID: Clad I.D.

POD: Pellet O.D.

BP: Backfill pressure

FDEN: Pellet density (bulk density when available, otherwise geometric density)

MAX IT: Maximum rod operating hrs. reflected in current FPDB history

MAX ABU: Maximum rod average burnup reflected in current FPDB history

The UAI traceability file is listed in Appendix B. As stated previously, more than one data record can exist for each rod, depending on the degree of resolution of the available parameters. For example, multiple pellet serial numbers could be associated with one rod. The usefulness of the UAI traceability file is that it uniquely identifies all rods of interest using the total population of ID parameters. In other words, at least one of the traceability parameters is included in each of the files transferred from the FPDB This fact provided the unifying structure for subsequent data processing software applications.

Review of the data acquisition results is discussed in more detail below relative to performance, design and operational parameters.

3.1 Performance Data Sample

The availability of certain categories of fuel rod material performance data was the criterion used to define the 293 rod data sample of current interest. The types of data available for each rod have been summarized in Table 5. Consistent with the "resolution" of performance data from Table 2, some of the performance parameters have dimensionality associated with them, i.e., multiple data points per rod. Also, many rods are seen to have multiple performance data categories. This is a desirable feature of the data sample, given the interdependence of thermal, mechanical, and chemical mechanisms in operating fuel rods, and the need to verify this dependence in FRAPCON fuel rod models.

Review of the FPDB performance data tables identified some data addition and change requirements; namely,

1. Missing (45 rods) or anomalous (15 rods) measurement times in tables 620 (TRACE INDEX) and 630 (ROD LENGTH) for Calvert Cliffs 1, Oyster Creek 8x8, and Peach Bottom 2 rods.

2. Correction of fuel rod serial numbers for 5 Calvert Cliffs 1 rods in Tables 629, 630, and 652 (ROD SPIRAL, ROD LENGTH, and ROD GAS tables) for consistency with TRACEABILITY parameters in Table 010.

3. Anomalous diameters (611 in.) for 3 Dresden 3 rods, and

4. Addition of end of life internal pressure data for 30 Oyster Creek 7x7 rods to Table 652 (ROD GAS table), because complementary data on gas conditions was already present for these rods, and replacement of any zero pressure values

TABLE 5: Rod Data Availability Summary for Current Power Reactor Data Sample

NROD	ECR(x,t) L,1D	ECR(x,t) L,2D	ECR(x,t) S,2D	ECX(t)	EFX(t)	GRE	GCOMP	PIN	ZRO2(x,t)	HPPM(x,t)
1			X	X						
2			X	X		X	X	X		
3			X	X						
4			X	X					X	
5			X	X					X	
6			X	X						
7			X	X					X	
8			X	X		X				
9			X	X		X			X	
10			X	X		X	X	X		
11			X	X		X	X	X		
12			X	X						
13			X	X		X	X	X		
14			X	X		X	X	X		
15			X	X		X	X	X		
16			X	X						
17			X	X						
18			X	X						
19			X	X					X	
20			X	X					X	
21			X	X		X	X	X		
22				X		X	X	X		
23			X	X						
24			X	X						
25			X							
26						X	X			
27							X			
28							X			
29			X			X	X	X		
30			X			X	X	X		
31						X	X	X		
32						X	X	X		
33						X	X	X		
34			X							
35			X			X	X	X		
36			X			X	X	X		
37			X			X	X	X		
38			X			X	X	X		
39	X									
40	X									
41	X									
42	X									
43	X									
44	X									
45	X									
46	X									

TABLE 5: Rod Data Availability Summary for Current Power Reactor Data Sample (Cont'd)

NROD	ECR(x,t) L,1D	ECR(x,t) L,2D	ECR(x,t) S,2D	ECX(t)	EFX(t)	GRE	GCOMP	PIN	ZRO2(x,t)	HPPM(x,t)
47		X			X					
48	X									
49	X									
50		X			X					
51	X									
52	X				X	X	X			
53		X			X	X	X			X
54	X									
55	X				X	X	X			
56	X									
57		X			X	X	X			
58	X				X	X	X			X
59	X									
60	X									
61	X				X	X	X			
62	X									
63	X				X	X	X			X
64	X									
65	X				X	X	X			
66	X									
67	X									
68			X	X	X					
69			X	X	X					
70			X	X	X					
71			X	X	X					
72			X	X	X					
73			X		X					
74			X	X	X					
75		X	X		X					
76		X	X		X					
77		X	X		X					
78		X	X		X					
79			X		X					
80		X	X							
81		X	X		X					
82		X	X							
83		X	X							
84					X	X	X	X		
85					X	X	X	X		
86					X	X	X	X		
87						X	X	X		
88						X	X	X		
89					X	X	X	X		
90						X	X	X		
91					X	X	X	X		
92						X	X	X		

TABLE 5: Rod Data Availability Summary for Current Power Reactor Data Sample (Cont'd)

NROD	ECR(x,t) L,1D	ECR(x,t) L,2D	ECR(x,t) S,2D	ECX(t)	EFX(t)	GRE	GCOMP	PIN	ZRO2(x,t)	HPPM(x,t)
93						X	X	X		
94					X	X	X	X		
95					X	X	X	X		
96					X	X	X	X		
97					X	[illegible]	X	X		
98					X	X	X	X		
99					X	X	X	X		
100						X	X	X		
101					X	X	X			
102					X	X	X	X		
103					X	X	X	X		
104						X	X	X		
105					X	X	X	X		
106					X	X	X	X		
107					X	X	X	X		
108						X	X	X		
109						X	X	X		
110					X	X	X	X		
111					X	X	X	X		
112						X	X	X		
113					X	X	X	X		
114						X	X	X		
115						X	X	X		
116						X				
117			X							
118			X			X	X			
119			X							
120			X							
121		X		X	X					
122		X		X						
123		X								
124		X	X							
125		X	X							
126		X	X		X					
127		X	X		X					
128		X	X							
129		X	X		X					
130			X		X					
131			X							
132			X		X					
133			X	X	X					
134			X	X	X					
135			X	X	X					
136			X	X	X					
137			X	X	X					
138			X	X	X					

TABLE 5: Rod Data Availability Summary for Current Power Reactor Data Sample (Cont'd)

NROD	ECR(x,t) L,1D	ECR(x,t) L,2D	ECR(x,t) S,2D	ECX(t)	EFX(t)	GRE	GCOMP	PIN	ZRO2(x,t)	HPPM(x,t)
139						X	X			
140			X							
141			X							
142			X			X	X	X		
143			X			X	X	X		
144			X			X	X	X		
145			X			X	X	X		
146			X			X	X	X		
147		X	X			X	X	X		
148		X	X			X	X	X		
* 149			X							
* 150			X							
* 151			X							
152						X				
153						X				
154						X				
155						X				
* 156						X				
* 157						X				
* 158						X				
* 159						X				
* 160						X				
* 161						X				
* 162						X				
* 163						X				
* 164						X				
* 165						X				
* 166						X				
* 167						X				
* 168						X				
169			X	X		X	X	X		
170			X	X	X	X	X	X	X	
171			X	X	X	X	X	X	X	
172			X	X	X	X	X	X	X	
173			X	X		X			X	
174			X			X			X	
175			X	X		X			X	
176			X	X						
177			X							
178			X	X						
179			X	X						
180			X	X					X	
181			X	X						
182			X	X						
183			X	X					X	
184			X	X						

TABLE 5: Rod Data Availability Summary for Current Power Reactor Data Sample (Cont'd)

NROD	ECR(x,t) L,1D	ECR(x,t) L,2D	ECR(x,t) S,2D	ECX(t)	EFX(t)	GRE	GCOMP	PIN	ZRO2(x,t)	HPPM(x,t)
185			X	X						
186	X				X	X	X			X
187	X				X	X	X			
188	X				X	X	X			
189	X				X	X	X			
190		X			X	X	X			
191		X			X	X	X			
192	X				X	X	X			
193	X									
194	X									
195	X									
196	X									
197	X									
198	X									
199	X									
200	X									
201	X									
202	X									
203	X									
204	X									
205	X									
206	X									
207	X									
208	X									
209	X									
210	X									
211	X				X					
212	X									
213		X			X					
214		X			X					
215		X				X	X			
216										
217		X		X						
218		X		X						
219		X		X						
220		X		X	X					
221					X					
222					X					
223					X					
224					X					
225					X					
226					X					
227					X					
228					X					
229					X					
230					X					

TABLE 5:Rod Data Availability Summary for Current Power Reactor Data Sample (Cont'd)

NROD	ECR(x,t) L,1D	ECR(x,t) L,2D	ECR(x,t) S,2D	ECX(t)	EFX(t)	GRE	GCOMP	PIN	ZRO2(x,t)	HPPM(x,t)
231					X					
232					X					
233	X			X	X	X	X			
234	X			X	X	X	X		X	
235	X			X	X	X	X		X	
236				X	X	X	X		X	
237				X	X	X	X			
238				X	X	X	X			
239				X	X	X	X			
240				X	X	X	X		X	
241				X	X	X	X			
242	X			X	X	X	X		X	X
243	X			X	X	X	X			
244	X			X	X	X	X		X	
245	X			X	X	X	X		X	X
246	X			X	X	X	X		X	
247	X			X	X	X	X			
248	X			X	X					
249				X	X	X	X		X	
250				X	X	X	X		X	
251	X			X	X	X	X		X	
252	X			X	X	X	X		X	
253	X				X	X	X		X	
254	X			X	X	X	X		X	X
255	X			X	X					
256	X			X	X	X	X			
257	X			X	X	X	X	X		
258	X			X	X	X	X	X		
259	X			X	X	X	X	X	X	X
260	X			X	X	X	X	X		
261	X			X	X	X	X	X		
262	X			X	X	X	X	X		
263	X			X	X	X	X	X	X	
264	X			X	X	X	X	X	X	X
265	X			X	X	X	X	X		
266	X			X	X	X	X	X		
267	X			X	X	X	X	X		X
268	X			X	X	X	X	X		
269	X			X	X					
270	X			X	X	X	X	X		X
271	X			X	X	X	X	X		
272	X			X	X	X	X	X		
273	X				X	X		X	X	
274	X				X	X		X	X	
275	X				X	X		X		
276	X				X	X		X		

TABLE 5: Rod Data Availability Summary for Current Power Reactor Data Sample (Cont'd)

NROD	ECR(x,t) L,1D	ECR(x,t) L,2D	ECR(x,t) S,2D	ECX(t)	EFX(t)	GRE	GCOMP	PIN	ZRO2(x,t)	HPPM(x,t)
277	X				X	X		X		
278	X				X	X		X		
279	X			X					X	
280	X			X					X	
281	X			X					X	
282	X			X					X	
283	X			X					X	
284	X			X					X	
285	X			X					X	
286	X			X					X	
287	X			X					X	
288	X			X					X	
289	X			X					X	
290	X			X					X	
291	X			X					X	
292	X			X					X	
293	X			X					X	
Total(a)	25	15	51	32	44	62	61	48	6	3
Total(b)	78	17	44	79	83	83	57	32	42	8
Total(c)	103	32	95	111	127	145	118	80	49	11

LEGEND:

ECR(x,t) : clad hoop strain; L,1D means linear 1 dimensional; L,2D means linear 2 dimensional; S,2D means spiral 2 dimensional; axial position and time dependent.

ECX(t) : clad axial strain; time dependent

EFX(t) : fuel axial strain; time dependent

GRE : fission gas release fraction; EOL

GCOMP : internal gas composition; fiss gas, helium, other gas; EOL

PIN : internal gas press; EOL

ZRO2(x,t) : clad surface corrosion thickness; axial position and time dependent

HPPM(x,t) : clad hydrogen content; axial position and time dependent

* : rod subsequently dropped from study due to lack of data

(a) rod group 1-123, FY-82 data acquisition campaign

(b) rod group 124-293, FY-83 data acquisition campaign

(c) all rods 1-293.

with -101 values (missing data flags).

The rods and tables affected by additions and changes to the FPDB performance data are summarized in Table 6. A table change for a given rod is indicated by an "X" symbol. No changes are indicated for the DOE rods (234 to 293) because complete performance data for these rods was manually added to the FPDB tables based on documentation sources.

The performance data availability is graphically compared in Figure 1 for Phase 1 and Phase 2 data samples in terms of the number of rods and data points for each of the seven data categories considered; namely, fission gas release (GRE), internal gas helium fraction (HEF), cladding hoop strain (ECR), cladding axial strain (ECX), fuel stack length change (EFX), rod internal pressure (PIN) and cladding surface corrosion (ZRO). The number of rods and data points for the total Phase 2 sample is printed for each category along the horizontal axis.

The number of rods for which performance data is now available in each category varies between 48 and 211. Significant increases in data availability are seen for all performance categories relative to the Phase 1 data acquisition results. Many of the 293 rods considered (≈70%) obviously generate data in more than one category, since the apparent sum of rods is 733. There is a relatively good balance between the representation of rods in thermal and mechanical performance areas, respectively 314 (GRE, HEF, PIN) versus 449 (ECR, ECX, EFX). The Phase 2 data evaluation marks the first consideration of corrosion data (ZRO), since so few rods were previously available in the Phase 1 sample.

The number of data points for each performance category is obviously dominated by the number of hoop strain (ECR) measurements as a result of multiple measurements per rod per cycle. This was also the case for the Phase 1 data sample. For GRE, HEF, and PIN, the number of measurements equals the number of rods, as expected.

The following sections will characterize the data points relative to design and operational parameters.

3.2 Design Parameters

Inspection of the FPDB table transfer results for those files which included design parameter fields, revealed numerous missing data flags (-101, -201). In order to limit the scope of table repairs that were necessary, the design parameters were prioritized as shown in Table 7.

TABLE 6: Rods Affected by Performance Data Additions and Changes to FPDB Tables

TABLE #

NROD	620	625	626	629	630	652		
1	X				X			
2	X				X			
3	X				X			
4	X				X			
5	X				X			
6	X				X			
7	X				X			
8	X				X	X		
9	X				X	X		
10	X				X			
11				X	X	X		
12								
13								
14								
15				X	X	X		
16				X	X	X		
17								
18								
19								
20								
21								
22								
23								
24								
25				X				
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								
41								
42								
43								
44								
45								
46								
47								
48								
49								
50								

TABLE #

NROD	620	625	626	629	630	652		
51								
52						X		
53						X		
54								
55						X		
56								
57						X		
58						X		
59								
60								
61						X		
62								
63						X		
64								
65						X		
66								
67								
68	X				X			
69	X				X			
70	X				X			
71	X				X			
72	X				X			
73	X				X			
74	X				X			
75	X							
76	X							
77	X							
78	X							
79	X							
80	X							
81	X							
82	X							
83	X							
84						X		
85						X		
86						X		
87						X		
88						X		
89						X		
90						X		
91						X		
92						X		
93						X		
94						X		
95						X		
96						X		
97						X		
98						X		
99						X		
100						X		

TABLE #

NROD	620	625	626	629	630	652		
101						X		
102						X		
103						X		
104						X		
105						X		
106						X		
107						X		
108						X		
109						X		
110						X		
111						X		
112						X		
113						X		
114								
115								
116								
117								
118								
119								
120								
121								
122								
123								

TABLE 6: Rods Affected by Performance Data Additions and Changes to FPDB Tables (continued)

TABLE #

NROD	620	625	626	629	630	652		
124								
125								
126								
127								
128								
129								
130								
131								
132								
133					X			
134					X			
135					X			
136					X			
137					X			
138					X			
139								
140				X				
141				X				
142								
143								
144								
145								
146								
147								
148								
149								
150								
151								
152								
153								
154					X			
155					X			
156						X		
157						X		
158						X		
159						X		
160						X		
161						X		
162						X		
163						X		
164						X		
165						X		
166						X		
167						X		
168						X		
169	X				X			
170	X				X			
171	X				X			
172	X				X			
173	X				X	X		

TABLE #

NROD	620	625	626	629	630	652		
174	X				X	X		
175					X	X		
176				X	X	X		
177	X				X			
178				X	X	X		
179								
180	X				X			
181								
182								
183								
184								
185	X				X			
186						X		
187						X		
188						X		
189						X		
190						X		
191						X		
192						X		
193								
194								
195								
196								
197								
198								
199								
200								
201								
202								
203								
204								
205								
206								
207								
208								
209								
210								
211								
212								
213								
214								
215								
216								
217								
218								
219								
220								
221								
222								
223								

TABLE #

NROD	620	625	626	629	630	652		
224								
225								
226								
227								
228								
229								
230								
231								
232								

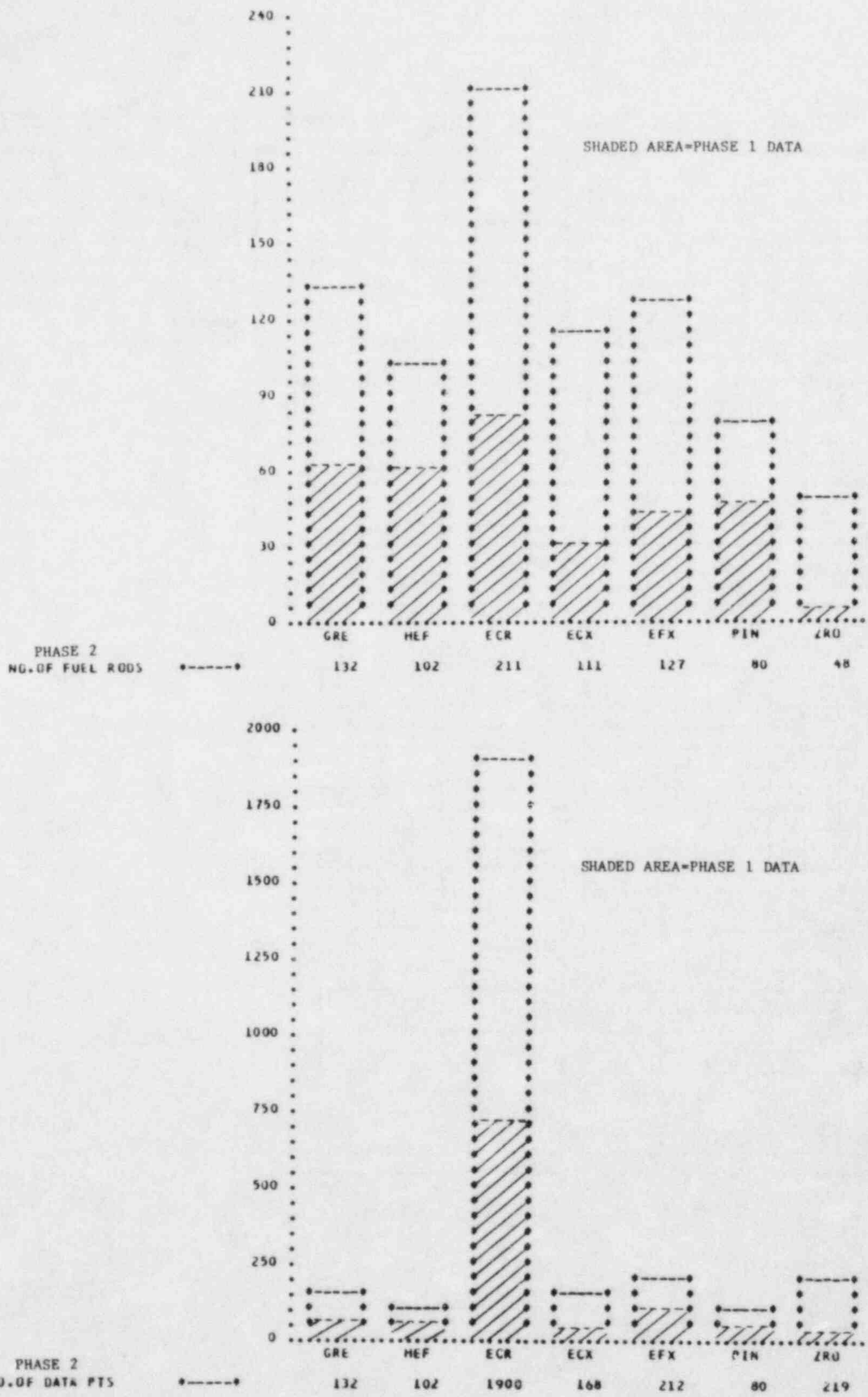


Figure 1: Total Data Availability Versus Data Category

Table 7: Prioritization of FPDB Design Parameters for Table Change Purposes

VITAL PARAMETERS			SECONDARY PARAMETERS				UNUSED PARAMETERS		
Item	Table#	Parameter[a]	Item	Table#	Parameter[a]	Assumed Value[b]	Item	Table#	Parameter
1	130	PGD/PBD	1	125	CFT/HFT	2900F	1	125	DBC
2	145	UIP	2	125	PBD-RBD/ABDI	0.0g/cc	2	130	OPO
3	150	POD	3	130	GS	10 um	3	130	DT
4	150	PEL	4	130	CSR	85 uin	4	130	PS
5	150	PUDD/PLDD	5	145	PEOTUR	2.0	5	145	N2IP
6	150	PUDDI/PLDDI	6	145	H2IPE	5 ppm	6	145	H2IP
7	310	TID	7	145	NIP	15 ppm	7	145	HIPE
8	310	TOD	8	150	PCHD	0.0	8	150	PTCW
9	505	BP	9	305	TM	Zircaloy	9	150	PBCW
10	510	RØL	10	305	TISR	12 uin	10	305	OST
11	510	TFL/AFL	11	305	FAT	(c)	11	305	TAN
12	510	PL	12	310	TWT	(TOD-TID)/2	12	310	TL
			13	320	TTT	(c)	13	310	TØV
			14	320	HYS	(c)	14	310	TE
			15	320	HAPR	1.0	15	505	BT
			16	320	HAPP	1.0	16	505	GET
			17	505	HEIFG	100.%	17	510	PV
			18	505	ARIFGA	0.0%	18	510	LECIL
			19	505	NIFG	0.0%	19	510	UECIL
							20	510	LSDL
							21	510	USDL

(a) slash(/) separates alternate parameters; for vital parameters, either one or the other alternate must be defined in repaired FPDB table; for secondary parameter, assumed value is used only if both alterrates are missing from FPDB table.

(b) value assumed for FRAPCON input, as opposed to data analysis purposes.

(c) these parameters would indicate degree of clad cold work; if unavailable, assume 0.0 cold work for 8x8 GE design and 0.10 cold work for all other designs.

"Vital" design parameters were those for which missing data flags had to be replaced with numerical data values. These values were based on either review of the various fuel surveillance program documents, or standard design practice as reported for example, in plant safety analysis reports or vendor publications. For vital parameters, in other words, there was less justification for applying an assumed value if better information could be found. The tables for which FPDB design parameters were repaired and the rods affected are identified in Table 8. No changes are indicated for the DOE rods (234 to 293) because vital design data for these rods was manually added to the FPDB tables based on documentation sources.

For the "secondary" and "currently unused" parameters listed in Table 7, no replacement of FPDB missing data flags was undertaken at this time, unless the information was found while reviewing data for vital parameters. It was felt that for secondary parameters, assumed values could be more efficiently applied by the data processing software outlined in Section 5. These are the parameters which are expected to have relatively little effect on the data and code evaluation results. Nevertheless, reasonable values were assigned to missing secondary parameters; for example "low" fuel water content (5 ppm) or 100% helium fill gas composition. Missing data for the currently unused parameters was not entered. These parameters are not expected to contribute to the current scope of data or code evaluation.

The previously referred to (Figure 1, bottom) data point distribution for each performance category was evaluated according to the fuel design types represented. Generic design distinctions were made based on reactor type and assembly array size; namely, "old" PWR (14x14, 15x15), "new" PWR (16x16, 17x17), "old" BWR (7x7), and "new" BWR (8x8). The results are graphically shown in Figure 2. Some of the plot symbols are not shown due to overlaying of values on the "y" axis.

The number of data points per category for each fuel design type is given at the bottom of Figure 2. With the exception of the EFX category, there is more PWR data than BWR data. This fact can be attributed to more PWR vendors being involved in the fuel surveillance programs. The availability of EFX and ZRO data reflects documentation rather than FPDB status, since these categories were manually added to the sample.

TABLE 8: Rods Affected by Design Data Additions and Changes to FPDB Tables

NROD	125	130	145	150	320	505	510	715
1	X							
2	X							
3	X							
4	X							
5	X							
6	X							
7	X							
8	X							
9	X							
10	X							
11	X							
12	X							
13	X							
14	X							
15	X							
16	X							
17	X							
18	X							
19	X							
20	X							
21	X							
22	X							
23	X							
24	X							
25	X			X	X		X	X
26	X			X	X		X	X
27	X			X	X		X	X
28	X			X	X		X	X
29	X							X
30	X							X
31	X							X
32	X							X
33	X							X
34	X							X
35	X							X
36	X							X
37	X							X
38	X							X
39	*X	X		*			X	
40	*X	X		*			X	
41	X	X					X	
42	X	X		X			X	
43	X	X					X	
44	X	X		X			X	
45	X	X					X	
46	X	X		X			X	
47	X	X					X	
48	X	X		X			X	
49	X	X					X	
50	X	X					X	

NROD	125	130	145	150	320	505	510	715
51	X	X		X			X	
52	X	X		X			X	
53	X	X		X			X	
54	*X	X		*			X	
55	X	X					X	
56	X	X		X			X	
57	X	X		X			X	
58	X	X					X	
59	X	X		X			X	
60	X	X		X			X	
61	X	X					X	
62	X	X					X	
63	X	X		X			X	
64	X	X		X			X	
65	X	X					X	
66	X	X					X	
67	X	X		X			X	
68	X	X		X	X	X		
69	X	X		X	X	X		
70	X	X		X	X	X		
71	X	X		X	X	X		
72	X	X		X	X	X		
73	X	X		X	X	X		
74	X	X		X	X	X		
75	X			X		X		
76				X		X		
77	X			X		X		
78				X		X		
79				X		X		
80				X		X		
81				X		X		
82				X		X		
83	X			X		X		
84	X	X	X	X	X	X	X	X
85	X	X	X	X	X	X	X	X
86	X	X	X	X	X	X	X	X
87	X	X	X	X	X	X	X	X
88	X	X	X	X	X	X	X	X
89	X	X	X	X	X	X	X	X
90	X	X	X	X	X	X	X	X
91	X	X	X	X	X	X	X	X
92	X	X	X	X	X	X	X	X
93	X	X	X	X	X	X	X	X
94	X	X	X	X	X	X	X	X
95	X	X	X	X	X	X	X	X
96	X	X	X	X	X	X	X	X
97	X	X	X	X	X	X	X	X
98	X	X	X	X	X	X	X	X
99	X	X	X	X	X	X	X	X
100	X	X	X	X	X	X	X	X

NROD	125	130	145	150	320	505	510	715
101	X	X	X	X	X	X	X	X
102	X	X	X	X	X	X	X	X
103	X	X	X	X	X	X	X	X
104	X	X	X	X	X	X	X	X
105	X	X	X	X	X	X	X	X
106	X	X	X	X	X	X	X	X
107	X	X	X	X	X	X	X	X
108	X	X	X	X	X	X	X	X
109	X	X	X	X	X	X	X	X
110	X	X	X	X	X	X	X	X
111	X	X	X	X	X	X	X	X
112	X	X	X	X	X	X	X	X
113	X	X	X	X	X	X	X	X
114				X	X			
115				X	X			
116								
117								
118								
119								
120								
121				X			X	
122				X			X	
123				X			X	

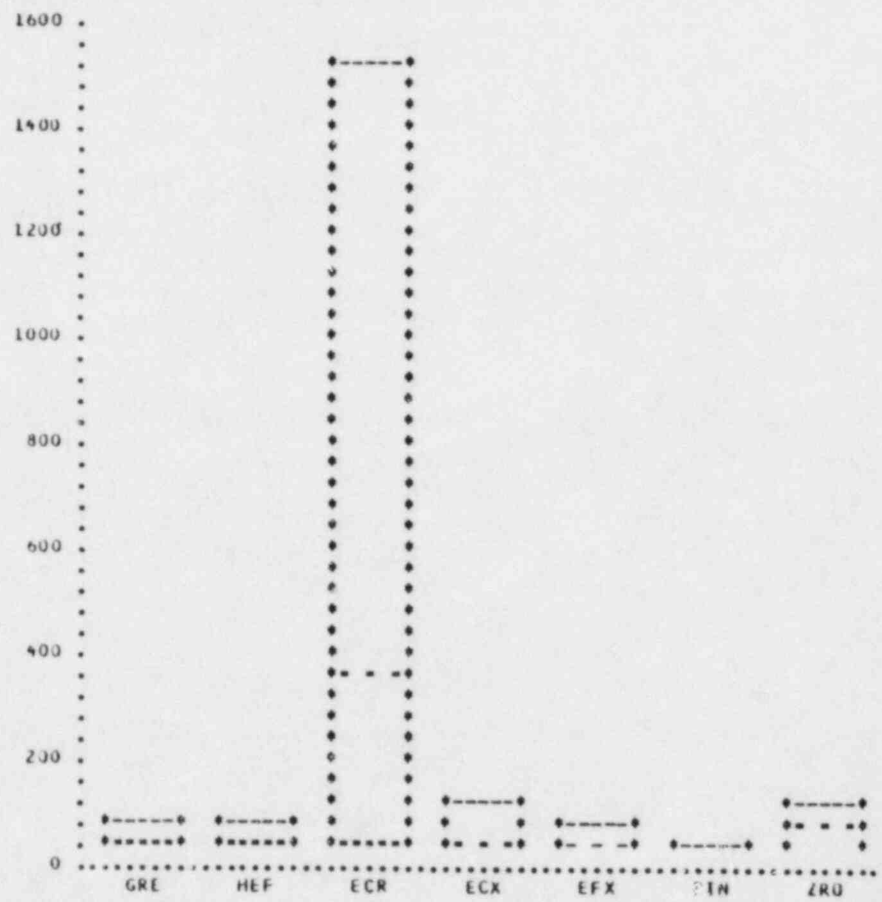
X numerical parameters
* traceability parameters

TABLE 8: Rods Affected by Design Data Additions and Changes to FPDB Tables (continued)

NROD	TABLE # 125	130	145	150	320	505	510	715
124						X		
125	X					X		
126						X		
127						X		
128						X		
129						X		
130						X		
131						X		
132						X		
133	X				X	X		
134					X	X		
135	X				X	X		
136					X	X		
137	X				X	X		
138	X				X	X		
139	X			X	X		X	X
140	X				X		X	X
141	X				X		X	X
142	X							X
143	X							X
144	X							X
145	X							X
146	X							X
147	X							X
148	X							X
149	X							X
150	X							X
151	X							X
152				X	X			
153				X	X			
154				X	X			
155				X	X			
156								
157								
158								
159								
160								
161								
162								
163								
164								
165								
166								
167								
168								
169	X							
170	X							
171	X							
172	X							
173	X							

NROD	TABLE # 125	130	145	150	320	505	510	715
174	X							
175	X							
176	X							
177	X							
178	X							
179	X							
180	X							
181	X							
182	X							
183	X							
184	X							
185	X							
186	X	X		X			X	
187	X	X		X			X	
188	X	X		X			X	
189	X	X					X	
190	X	X					X	
191	X	X					X	
192	X	X		X			X	
193	*X	X		X*			X	
194	*X	X		X*			X	
195	*X	X		X*			X	
196	X	X					X	
197	X	X		X			X	
198	X	X					X	
199	X	X		X			X	
200	X	X					X	
201	X	X					X	
202	X	X		X			X	
203	X	X		X			X	
204	X	X					X	
205	X	X		X			X	
206	X	X					X	
207	X	X		X			X	
208	X	X					X	
209	X	X					X	
210	X	X					X	
211	X	X		X			X	
212	X	X		X			X	
213	*X	X		*X			X	
214	X	X		X			X	
215								
216				X	X			
217				X			X	
218				X			X	
219				X			X	
220				X			X	
221		X		X				
222		X		X				
223		X		X				

NROD	TABLE # 125	130	145	150	320	505	510	715
224		X		X				
225		X		X				
226		X		X				
227		X		X				
228		X		X				
229		X		X				
230		X		X				
231		X		X				
232		X		X				



		GRE	HEF	ECR	ECX	EFX	PIN	ZRO
OLD PWR (14,15)	*------*	94	66	1516	110	76	49	129
NEW PWR (16,17)	*- - -*	0	0	0	0	12	0	0
OLD BWR (7)	*======*	32	34	18	0	80	29	0
NEW BWR (8)	*= = =*	6	2	366	58	44	2	90

Figure 2: Total Data Availability Versus Data Category
for Various Fuel Designs

The "older" fuel designs still dominate the PWR and BWR data categories with the exception of the BWR clad hoop strain, axial strain, and corrosion categories. This is expected since the FPDB contents have not kept up with the reporting of fuel surveillance data for the "newer" designs, particularly for PWR data which is generated mainly by DOE programs. From the design diversity perspective, the current Phase 2 data sample is still much improved over the Phase 1 sample. The greatest relative increases in data availability occurred for the PWR and new BWR design categories. Operational parameters for these rods are reviewed in the next section.

3.3 Operational Parameters

As previously indicated in Table 2, the operational parameters characterize the fuel rod duty history relative to axial power distribution and system environment. Inspection of the FPDB table transfer results for operational parameters revealed the following change requirements, as summarized in Table 9:

1. For about 100 rods (Oyster Creek 7x7, Oconee 2, Surry 2), complete rod power and axial profile histories were not available in Table 533; for about 30 Calvert Cliffs 1 rods, minor anomalies were noted in Table 533, such as irradiation times occurring between cycles and separated power history segments.

2. For about 90 rods, either some (Oyster Creek 7x7) or all (Oconee 2) cycles of core and system history data were missing from Table 901.

3. For about 85% of the rods, the axial burnup distribution as a function of time was not available in Table 537, and

4. Most of the relevant reactor operating cycles had been defined in Table 900, with the exception of one Peach Bottom 2, Surry 2, and Calvert Cliffs 1 cycle, and 2 early Oyster Creek cycles.

Considering the scope of effort involved to define complete operational conditions for all the rods, it was decided to make Table 533 the basis of minimum rod power history detail, and use Table 901 reactor histories to determine downtime and add finer resolution whenever possible. If the FPDB data from both Tables 533 and 901 were present, and this data covered the desired number of cycles defined in Table 900, no data additions were necessary. If Table 533 data was missing, manual data with built-in down time was inserted based on

TABLE 9: Rods Affected by Operational Data Additions and Changes to FPDB Tables

	TABLE #							
NROD	533	900	901	–	–	–	–	–
1	X	X						
2	X							
3	X	X						
4	X	X						
5	X	X						
6	X	X						
7	X	X						
8	X	X						
9	X	X						
10	X							
11								
12								
13								
14								
15	X							
16	X							
17	X							
18	X							
19	X							
20	X							
21	X							
22	X							
23	X							
24	X							
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39	X		X					
40	X		X					
41	X		X					
42	X		X					
43	X		X					
44	X		X					
45	X		X					
46	X		X					
47	X		X					
48	X		X					
49	X		X					
50	X		X					

	TABLE #							
NROD	533	900	901	–	–	–	–	–
51	X		X					
52	X		X					
53	X		X					
54	X		X					
55	X		X					
56	X		X					
57	X		X					
58	X		X					
59	X		X					
60	X		X					
61	X		X					
62	X		X					
63	X		X					
64	X		X					
65	X		X					
66	X		X					
67	X		X					
68								
69								
70								
71								
72								
73								
74								
75								
76								
77								
78								
79								
80								
81								
82								
83								
84	X	X	X					
85	X	X	X					
86	X	X	X					
87	X	X	X					
88	X	X	X					
89	X	X	X					
90	X	X	X					
91	X	X	X					
92	X	X	X					
93	X	X	X					
94	X	X	X					
95	X	X	X					
96	X	X	X					
97	X	X	X					
98	X	X	X					
99	X	X	X					
100	X	X	X					

	TABLE #							
NROD	533	900	901	–	–	–	–	–
101	X	X	X					
102	X	X	X					
103	X	X	X					
104	X	X	X					
105	X	X	X					
106	X	X	X					
107	X	X	X					
108	X	X	X					
109	X	X	X					
110	X	X	X					
111	X	X	X					
112	X	X	X					
113	X	X	X					
114		X						
115		X						
116								
117								
118								
119								
120								
121								
122								
123								

TABLE 9: Rods Affected by Operational Data Additions and Changes to FPDB Tables (continued)

TABLE #

NROD	533	900	901	—	—	—	—	—
124								
125								
126								
127								
128								
129								
130								
131								
132								
133								
134								
135								
136								
137								
138								
139								
140								
141								
142								
143								
144								
145								
146								
147								
148								
149								
150								
151								
152		X						
153		X						
154		X						
155		X						
156								
157								
158								
159								
160								
161								
162								
163								
164								
165								
166								
167								
168								
169	X							
170	X							
171	X							
172	X							
173	X	X						

TABLE #

NROD	533	900	901	—	—	—	—	—
174	X	X						
175	X	X						
176	X							
177	X	X						
178								
179	X							
180	X	X						
181								
182								
183	X							
184								
185	X	X						
186	X		X					
187	X		X					
188	X		X					
189	X		X					
190	X		X					
191	X		X					
192	X		X					
193	X		X					
194	X		X					
195	X		X					
196	X		X					
197	X		X					
198	X		X					
199	X		X					
200	X		X					
201	X		X					
202	X		X					
203	X		X					
204	X		X					
205	X		X					
206	X		X					
207	X		X					
208	X		X					
209	X		X					
210	X		X					
211	X		X					
212	X		X					
213	X		X					
214	X		X					
215								
216								
217								
218								
219								
220								
221	X	X	X					
222	X	X	X					
223	X	X	X					

TABLE #

NROD	533	900	901	—	—	—	—	—
224		X	X					
225		X	X					
226	X	X	X					
227	X	X	X					
228	X	X	X					
229		X	X					
230	X	X	X					
231	X	X	X					
232		X	X					

documentation. If both Table 533 and 901 data was missing, the same procedure was used and constant system conditions were inserted in Table 901. Missing cycles were defined in Table 900 (item 4) and minor anomalies (item 1) replaced in Table 533 as required.

For the DOE rods, complete rod power histories and simplified system histories were added to Tables 533 and 901 respectively. Due to lack of documentation, Monticello rod histories (rods 279-293) had to be derived from core physics results provided by Northern States Power Company.

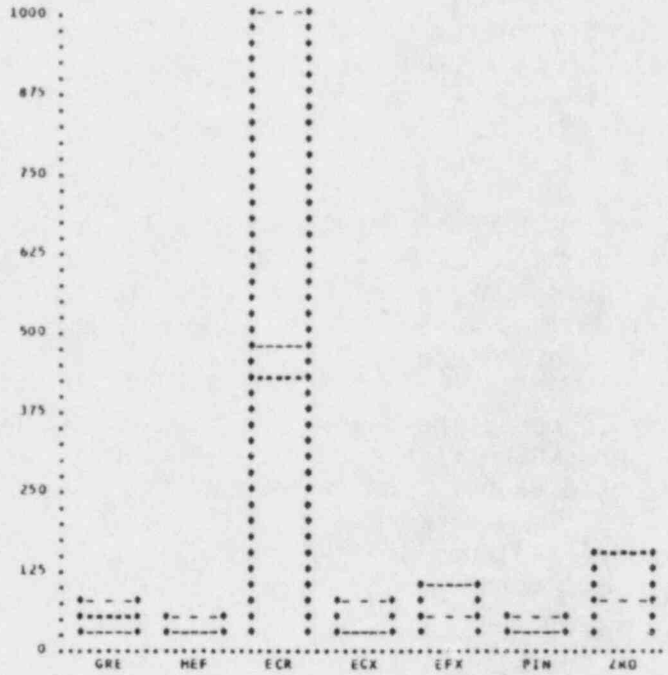
For all rods, the power levels were fine turned by adjustment factors which resulted in end-of-cycle burnups matching reported values from documentation.

The original operational parameters, augmented by necessary changes, were then graphically characterized as discussed below.

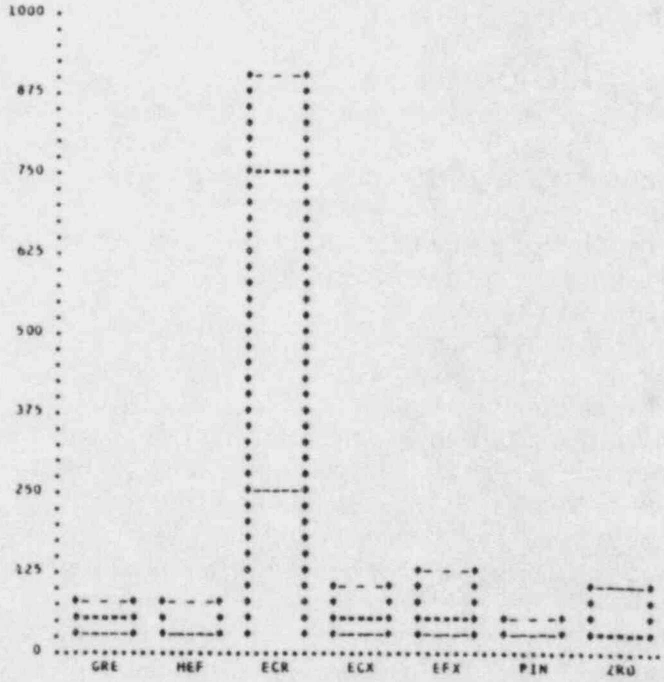
Figure 3 illustrates the relative data point abundance of various power and burnup conditions for each performance category in the current sample. The power and burnup ranges spanned by the rod operating conditions have been subdivided into low, medium and high ranges. This is considered sufficient resolution for the present surrey purposes and sample size.

The power and burnup ranges shown in Figure 3 refer to different local or average conditions depending on the data category. These characteristic power and burnup parameters are defined in Table 10. The rationale for choosing these parameters is simply to associate the data with those average or local conditions that are expected to influence the data response. Physically consistent data responses provide a means of qualifying the data, as discussed later in section 4.

With the exception of corrosion (ZRO) data, the representation of rod performance for low, medium, and high power ranges (Figure 3) reflects dominance of the data sample by moderate power levels. Between 50 and 65% of the data reflect operating conditions of 5 to 7.5 Kw/ft. This is not an undesirable feature in view of the relative abundance of "core average rods" when the overall core material conditions are of interest. A significant fraction of the data (20 to 40%) represents the higher power range somewhere between core average and lead rod



		GRE	HEF	ECR	ECX	EFX	PIN	ZRO
3-18 GWD/MTM	*------*	16	17	468	17	108	13	0
18-33 GWD/MTM	*- - -*	68	58	992	66	55	46	71
GT. 33 GWD/MTM	*******	48	27	432	82	44	21	148



		GRE	HEF	ECR	ECX	EFX	PIN	ZRO
2.5- 5.0 KW/FT	*------*	10	10	241	22	28	10	102
5.0- 7.5 KW/FT	*- - -*	73	65	908	108	125	49	96
7.5-10.0 KW/FT	*******	49	27	749	38	59	21	19

Figure 3: Total Data Availability Versus Data Category for Various Power and Burnup Ranges

TABLE 10: Characteristic Power and Burnup Parameters Used for Evaluation of Each Data Category

Category	Power Parameter	Burnup Parameter
GRE	Max rod avg. power among the avg. powers for each cycle	end-of-life rod avg burnup
HEF	Same as GRE	Same as GRE
ECR	Max local power at measurement location from BOL to end of measurement cycle.	local burnup at measurement location at end of measurement cycle.
ECX	Max rod avg. power from BOL to end of measurement cycle.	Rod avg. burnup at end of measurement cycle
EFX	Same as ECX	Same as ECX
PIN	Same as GRE	Same as GRE
ZRO	Avg. local power at measurement location from BOL to end of measurement cycle	Same as ECR

conditions. Again, with the exception of the ZRO data, only 8 to 15% of the measurements represent the less limiting low power range below 5 Kw/ft.

Data availability for different burnup ranges in Figure 3 reflects the developing nature of high burnup fuel surveillance results. In other words there is a tendency for the data population to build up first in the low and moderate burnup ranges, as production fuel is discharged and high burnup fuel accumulates duty. The Phase 1 data sample was particulary limited in this regard. The Phase 2 data sample however,is beginning to reflect significant amounts of high burnup measurements in all performance categories. Compared to Phase 1 results, the greatest increases in relative data availability occurred for the high burnup range (> 33 GWD/MTM). This was the main incentive for manually coding and appending Zorita, Oconee 1, and Monticello data from DOE programs to the FPDB files from EPRI. As will be discussed in Section 4, the maximum local burnups reflected in the present data sample are about 60000 MWD/MTM.

4.0 DATA ANALYSIS

Section 2 and 3 documented the acquisition and review of various power reactor fuel performance data resources. The following section further characterizes each performance data category in two ways; namely,

1. the data distribution from both an overall perspective and in relation to design and operational parameters, and

2. the data response to variation in operational parameters such as local power and burnup conditions.

The objective here is not to explain every nuance of fuel behavior, but simply to present the data acquisition results and establish whether these are consistent with physical expectations and interpretation of fuel performance by other investigators.

4.1 Data Distributions

Figures 4 through 10 show the data point frequency versus the data range values for each of the 7 performance categories previously defined in Section 3.1 (GRE, HEF, ECR, ECX, EFX, PIN and ZRO). In each case, the total data range (i.e., minimum to maximum value) is represented by the "x" axis. This range has been divided into 6 equal subintervals. As a result, the frequency of performance measurements can be evaluated relative to what sort of mechanisms are indicated by the data, for example, the association of positive clad hoop strain with pellet-clad gap closure conditions. The upper left hand plot in Figures 4 through 10 refers to the total number of data points being considered. The other three plots in each figure further distinguish the data on the basis of power, burnup, and design parameters.

The distributions of the 132 fission gas release data points are shown in Figure 4. The distributions appear bi-modal in that about 65% of the rods have low fission gas release (<5%) while the balance have more than 10% fission gas release. Once the gas release is "high", a wider range of gas release is possible due to thermal feedback. This observation is consistent with the Phase 1 results.

Inspection of the data distributions relative to power, burnup, and design parameters indicates the following trends:

1. Both low and high gas release can occur for any of these power ranges, although above 10%, the gas release becomes more proportional to power.

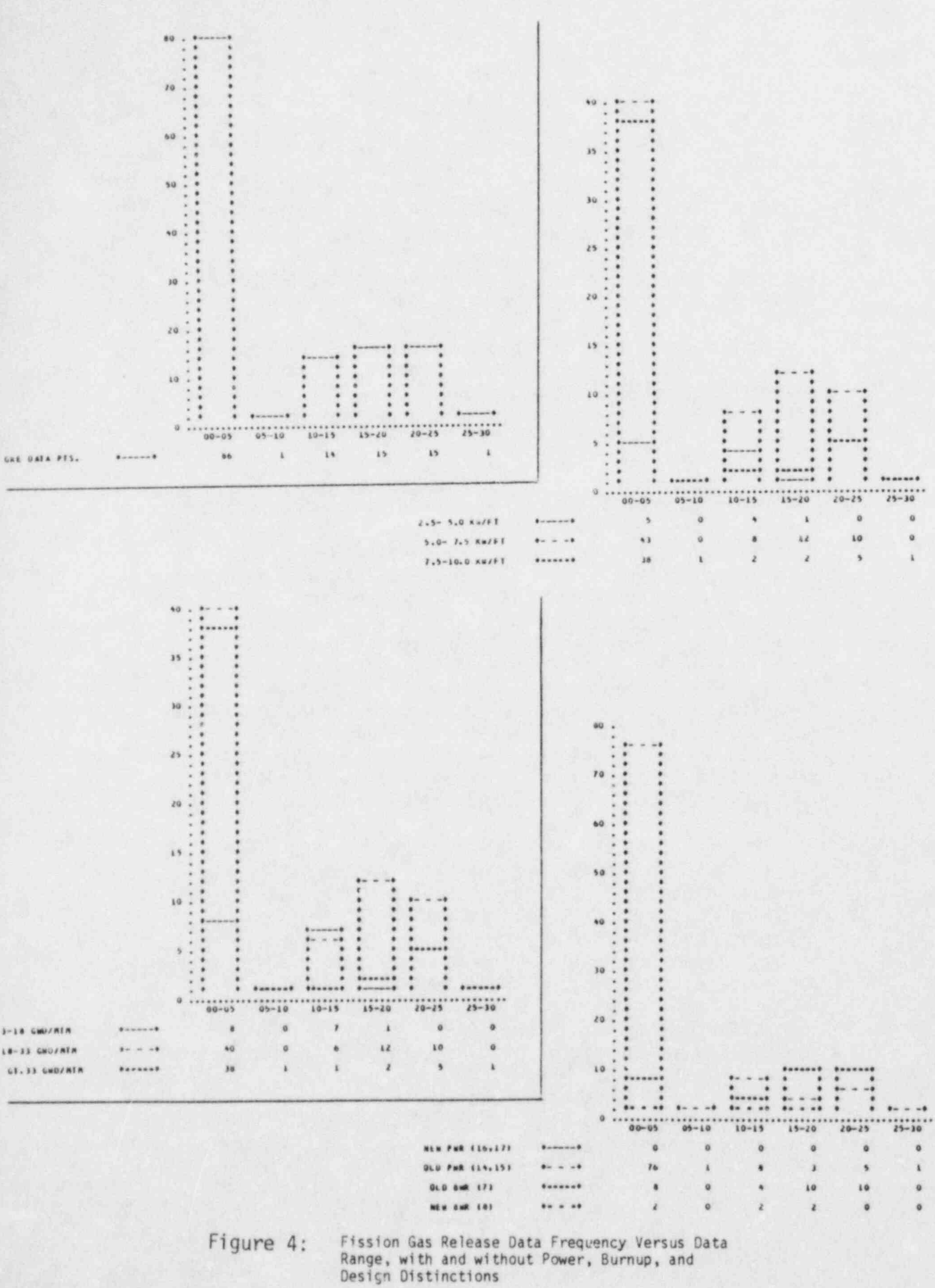


Figure 4: Fission Gas Release Data Frequency Versus Data Range, with and without Power, Burnup, and Design Distinctions

2. Both low and high gas release can occur at different burnup levels, although above 10% the gas release becomes more proportional to burnup.

3. 91% of the high gas release data points are associated with unpressurized rods, while low gas release more evenly represents both pressurized and unpressurized rods.

The above trends are not unexpected since the fission gas release is dependent on diffusion kinetics. In other words, the gas release is dependent on time and fuel microstructure, as well as temperature.

For example, a cycle of high power operation may not cause high gas release if the burnup (gas inventory) is low, or the fuel grain size is large, or the fuel porosity is closed (not connected to the rod void volume). Also, unpressurized rods are more sensitive to burnup induced changes in the pellet and gap heat transfer resistance. As a result, the unpressurized rods start out with low gas release, but once some threshold gas release occurs, higher fuel temperatures and further gas release will result. Once significant gas release has occured, it also seems reasonable for further releases to respond more directly to variation in power and burnup conditions, since the overall diffusion process would no longer be dominated by storage effects.

The data point distributions for rod internal gas composition (helium fraction) are shown in Figure 5. Both the overall and parametric distributions are consistent with the gas release results previously seen in Figure 4. Both figures in fact refer in large part to the same rods. The lower range of helium fractions are associated with higher burnups, higher power levels, and older (unpressurized) BWR and PWR designs. High helium fractions can occur at any power or burnup prior to saturation of gas storage in the UO_2 matrix and between grains. Consistency between gas release and gas composition trends also indicates proper entry and retrieval of different but related performance parameters into the FPDB structure.

The distributions of cladding hoop strain data are shown in Figure 6. The total data distribution in the upper left plot is dominated by negative strains as expected from Phase 1 results and from creep down being the primary clad deformation mechanism below 40 GWD/MTM. Unlike the gas condition data in Figures 4 and 5, the hoop strain data distribution is centually peaked. Only about 5% of the data points occupy the "tails" of the distribution (<-1.0, >0.2%). This indicates that the current data sample mainly reflects a gradual mechanism such as creep down, i.e., a mechanism without threshold effects

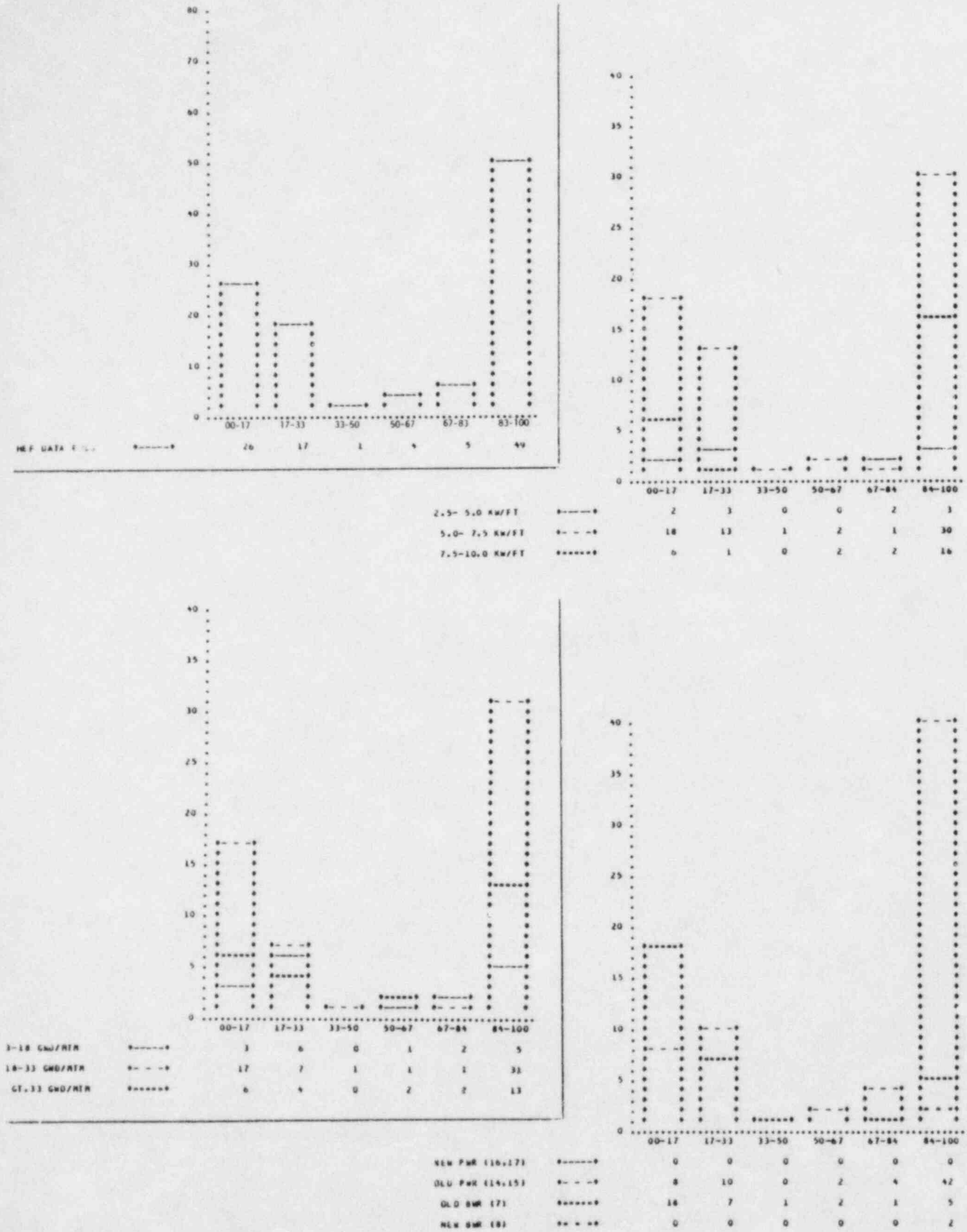


Figure 5: Internal Gas Helium Fraction Data Frequency Versus Data Range, with and without Power, Burnup, and Design Distinctions

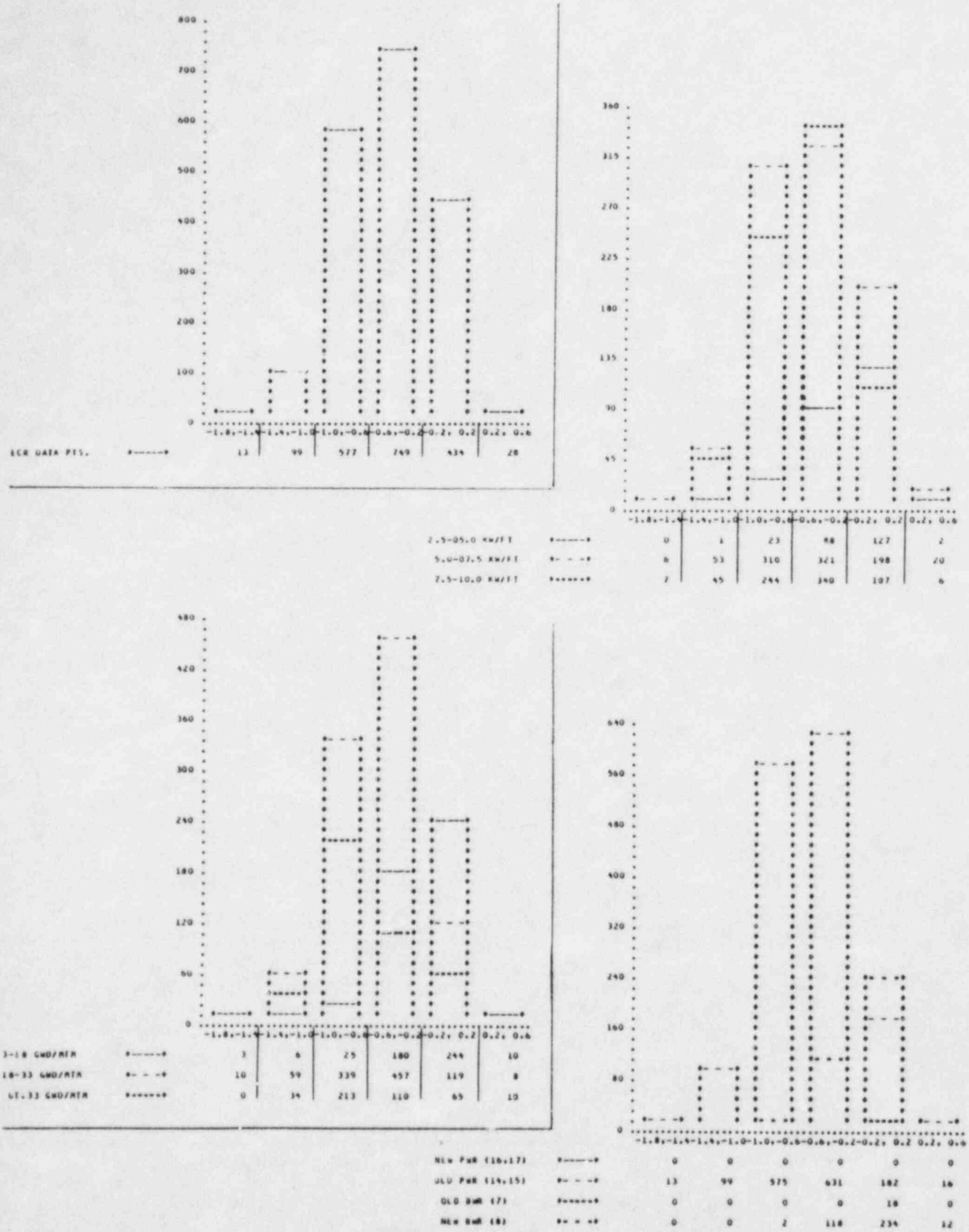


Figure 6: Cladding Hoop Strain Data Frequency Versus Data Range, with and without Power, Burnup, and Design Distinctions

"splitting-up" the distribution as previously seen in the gas release data. A clad strain data sample which was more governed by PCI effects would show more tendency for a bi-modal distribution.

The graphically indicated effects of power, burnup, and design on the clad hoop strain distribution include the following:

1. The fact that both moderate and higher power levels have a similar data distribution indicates that the gap is either open or softly closed in both cases; the fact that low power data appear to have less propensity for negative strain is instead the result of this data being mainly for BWR rods.

2. The strain distributions are skewed towards more negative values as burnup increases; gap closure and subsequent fuel swelling effects on clad strain apparently have not yet compensated for creep collapse at these burnups, partly because many rods had densifying fuel.

3. The hoop strain data distributions are dominated by older design PWR rods, which predictably have the more negative strain values compared to BWR rods.

The current hoop strain data distributions are physically consistent with expected power reactor fuel performance trends for "free standing" cladding. The data sample is dominated by "old" PWR and "new" BWR design types. Subsequent FPDB versions should increase the representation of gap closure effects due to availability of higher burnup data and more widespread use of non-densifying fuel. The fact that the largest data sample was successfully reduced, stored, and retrieved also indicates proper functioning of the data processing arrays and software.

Figure 7 shows the distributions of the clad axial strain data. The Phase 2 data availability for this performance category was greatly expanded relative to Phase 1 results (168 vs. 43 points). About 95% of the data occupy the range below 0.6% strain. The higher strains correspond to more than 50% of the typical as-built axial clearance between rod and assembly structures. The magnitude of this effect shows why high burnup designs require increased axial clearance to prevent rod bowing.

Review of the power, burnup, and design parameter effects on the axial strain distribution indicates these trends:

1. With the exception of a few points, the lowest power data corresponds to the lowest strain values; moderate and high power distributions have the same general shape, which indicates the absence of hard PCI effects.

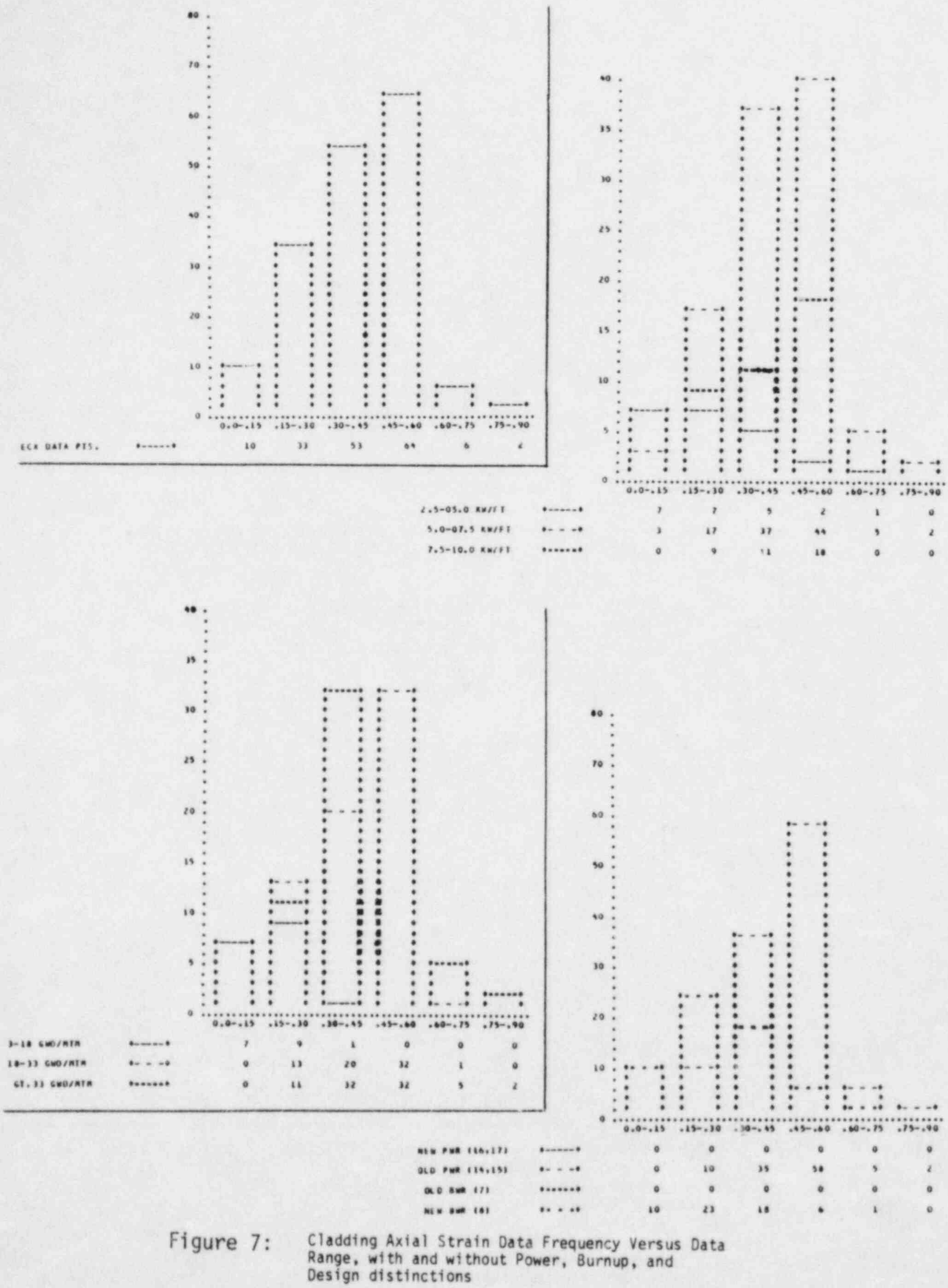


Figure 7: Cladding Axial Strain Data Frequency Versus Data Range, with and without Power, Burnup, and Design distinctions

2. Dominance of the burnup (irradiation growth) effect on this data is apparent since the range of strains is seen to be proportional to burnup.

3. The fact that newer design BWR rods have less strain than older design PWR rods is indicative of both design and burnup trends, since most of these BWR rods either employed annealed cladding or operated to relatively low burnup.

The distributions of cladding axial strain data appear physically reasonable for power reactor conditions. Like the hoop strain data sample, the axial strains only represent "old" PWR and "new" BWR design types. Since the main axial strain mechanism (irradiation growth)is not dependent on rod geometry, this data should be more generally applicable than the hoop strain data.

The distributions of fuel axial elongation data are shown in Figure 8. Like the Phase 1 results, the total data distribution shows that most of the fuel stack strains are negative. Predominance of negative strain for this sample is a result of fuel densification not yet being overcome by fission product swelling. Some 40% of the newly added Phase 2 data, however, exhibit positive deformation, which indicates less densification and/or more fuel swelling for the new fuel types and burnup levels. This trend is consistent with the Phase 2 data acquisition emphasis. Given an initial plenum length of 4-8% of the stack length, it is evident that fuel axial densification and swelling can produce significant internal void volume (and pressure) changes in power reactor fuel rods.

The effects of power, burnup, and design type on the EFX data distributions can be summarized as follows:

1. The majority (60%) of the data reflects moderate power conditions and is skewed toward negative strain (densification); about 30% of the data reflects high power conditions and is more governed by swelling (positive strain); the balance (13%) of the data reflects low power operation and is associated with small strains.

2. The low and moderate burnup data distributions indicate more influence of densification while the high burnup distribution indicates more influence of swelling; this observation is consistent with the rapidity of fuel instability and the slow recovery effects of swelling.

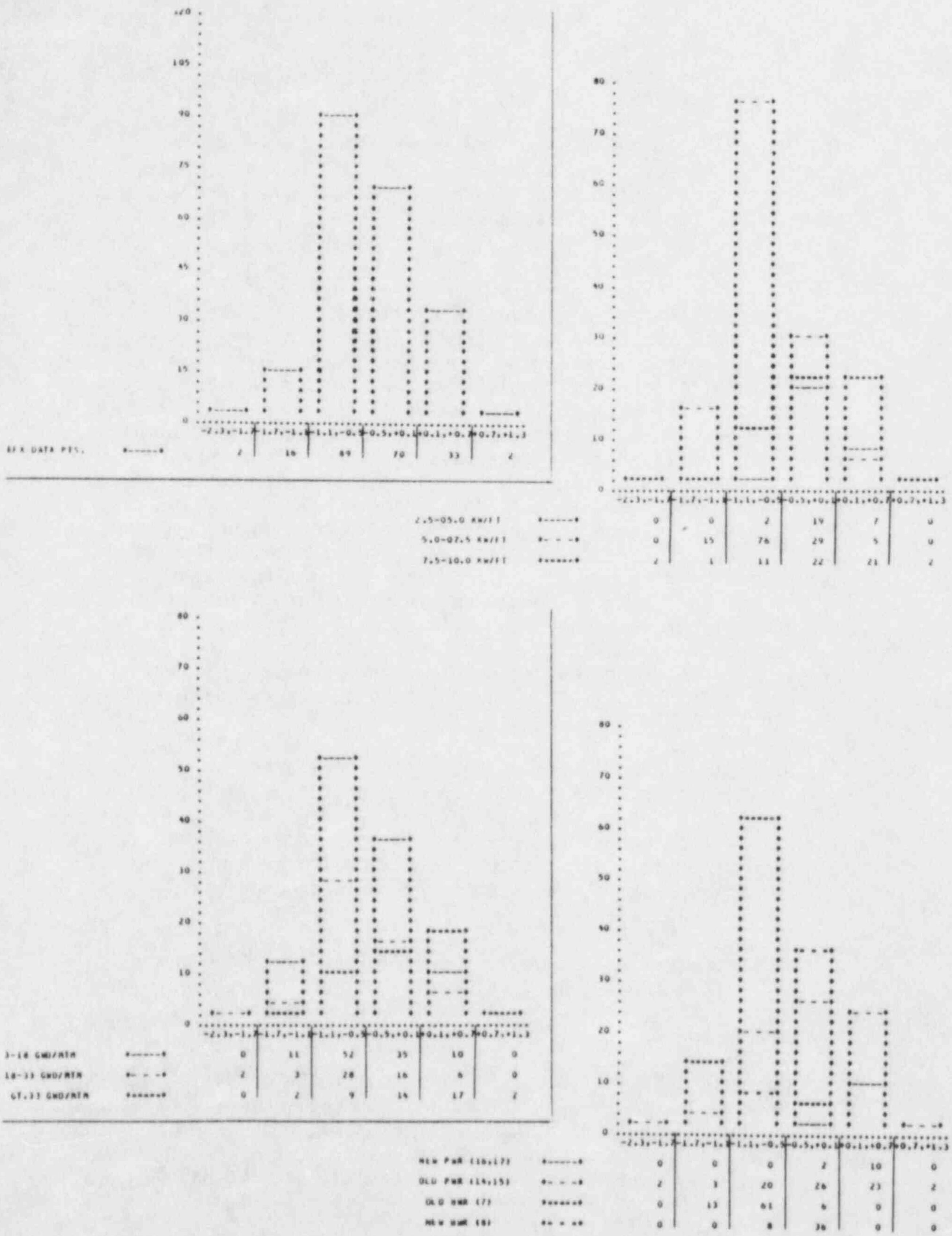


Figure 8: Fuel Axial Elongation Data Frequency Versus Data Range, with and without Power, Burnup, and Design distinctions

3. As expected, densification effects are associated with the "older" BWR and PWR designs, while swelling effects are associated with the "newer" designs.

The fuel axial elongation data distributions indicate physically reasonable densification and swelling components. As stated previously, this data category was manually added to the FPDB results. Reasonable data distributions indicate proper merging of the manual data with the FPDB data processing procedures.

The distributions of relative end of life (EOL) internal pressure data are shown in Figure 9. This is the smallest size (80) considered in the current data evaluation scope, so the results are less conclusive compared to the other data categories. The end of life pressure at PIE conditions (assumed here to be comparable to room temperature conditions) has been normalized by the as-built pressure. As a result, this "relative" pressure parameter is proportional to the ratio of EOL/BOL gas content (moles) and BOL/EOL gas volume. The relative pressure integrates the key burnup mechanisms treated separately in other data categories; namely, fission gas release and both fuel and cladding deformation. Similar to the case of the fission gas related data categories (GRE and HEF), the relative pressure distribution seems bi-modal. This suggests dominance of the current relative pressure data by gas release as opposed to deformation effects. This observation is consistent with the Phase 1 data evaluation results.

The effects of power, burnup, and design parameters on the data distributions in Figure 9 suggest the following trends:

1. Similar to the gas release results,low, moderate, and high power levels can result in either low or high relative pressure, based on other factors governing fission gas release.

2. When combined with item 1, the fact that low, moderate, and high burnups can be associated with either low or high relative pressures indicates strong influence of design and fabrication parameters.

3. The data distributions are fairly distinct for the various design types which constitute the internal pressure data sample ; only unpressurized rods have relative pressure values greater than 2.2; the lowest range mainly represents pressurized PWR rods and 8x8 BWR

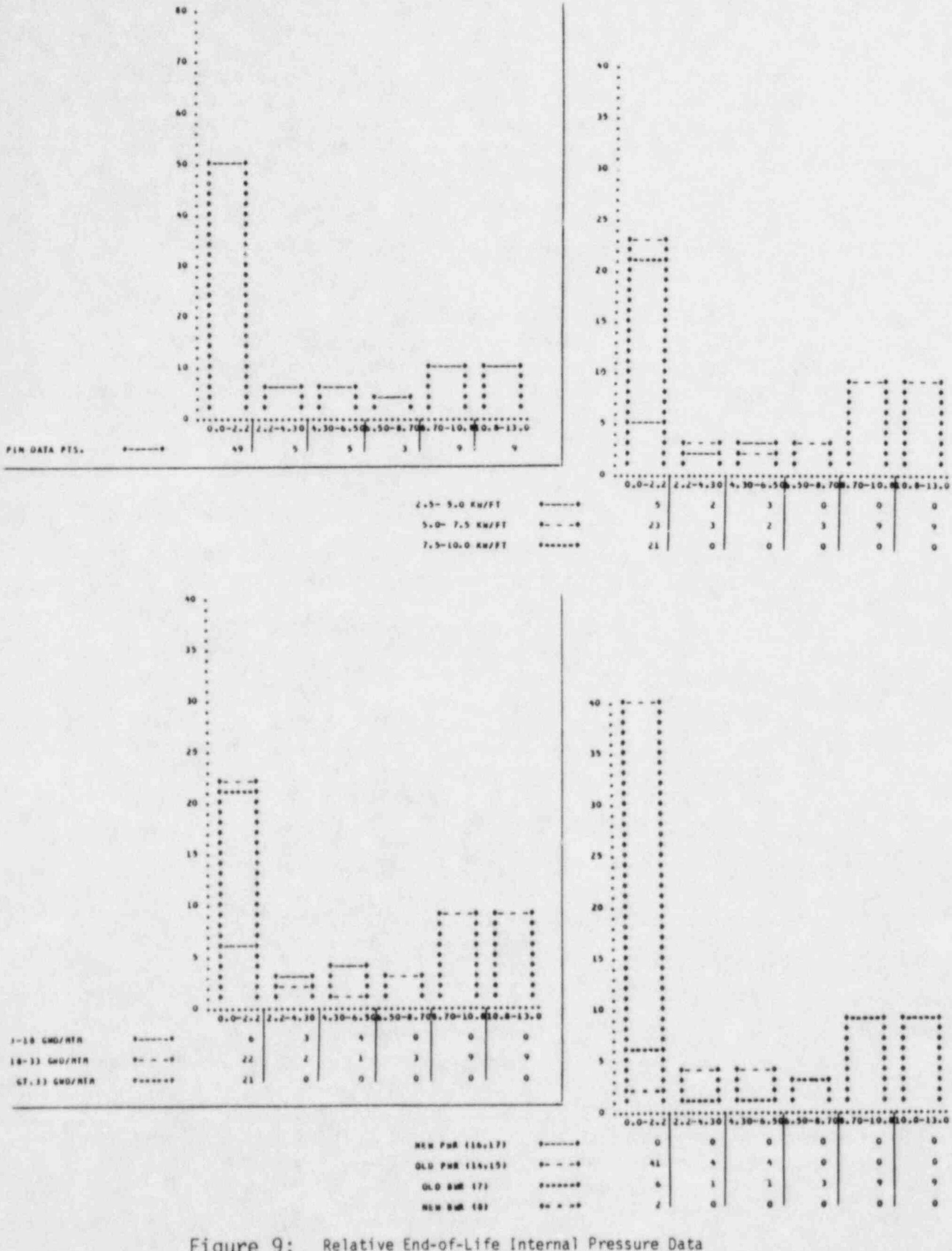


Figure 9: Relative End-of-Life Internal Pressure Data Frequency Versus Data Range, with and without Power, Burnup, and Design Distinctions

rods; only "old" BWR rods with relatively unstable fuel have relative pressure values greater than 6.5; these observations confirm the governing influence of design and fabrication parameters on subsequent void volume and gas release changes.

The relative pressure data distributions indicate physical trends that are consistent with the gas release and helium fraction data.

The distributions of cladding surface corrosion data are shown in Figure 10. As stated previously, this fuel rod performance category was not considered in the Phase 1 data evaluation results. More than 85% of the measurements occupy the lower half (<1.2 mils) of the data range. This indicates a relatively "clean" coolant chemisty and associated low crud deposition for the 48 rods involved or an absense of nodular data. Even for the maximum corrosion layer buildup, less than 10 % of the cladding wall has locally reacted for this data sample.

The apparent effects of power, burnup, and fuel design on the clad corrosion data distributions can be summarized as follows:

1.) The power effect is inconclusive since similar data distributions are obtained for the low, medium and high ranges considered.

2.) The data reflects only moderate and high burnup conditions (35 and 65% of the sample, respectively); the moderate and high burnup data are similarly distributed which (combined with item 1) indicates the expected governing influence of coolant conditions.

3.) Only "old" PWR and "new" BWR rods are represented in the clad corrosion data sample; for the Monticello, Calvert Cliffs, and Zorita rods considered, there is some tendency for the thicker corrosion layers to be associated with Monticello rods, as expected from their longer core residence times (53000 hrs versus 30-40000 hrs).

Overall, the data distributions presented in this section are more representative of high burnup fuel design, operational, and performance conditions than the data previously used for the Phase 1 FRAPCON assessment. The next section furtner characterizes each of the performance categories in terms of data response to power and burnup variations.

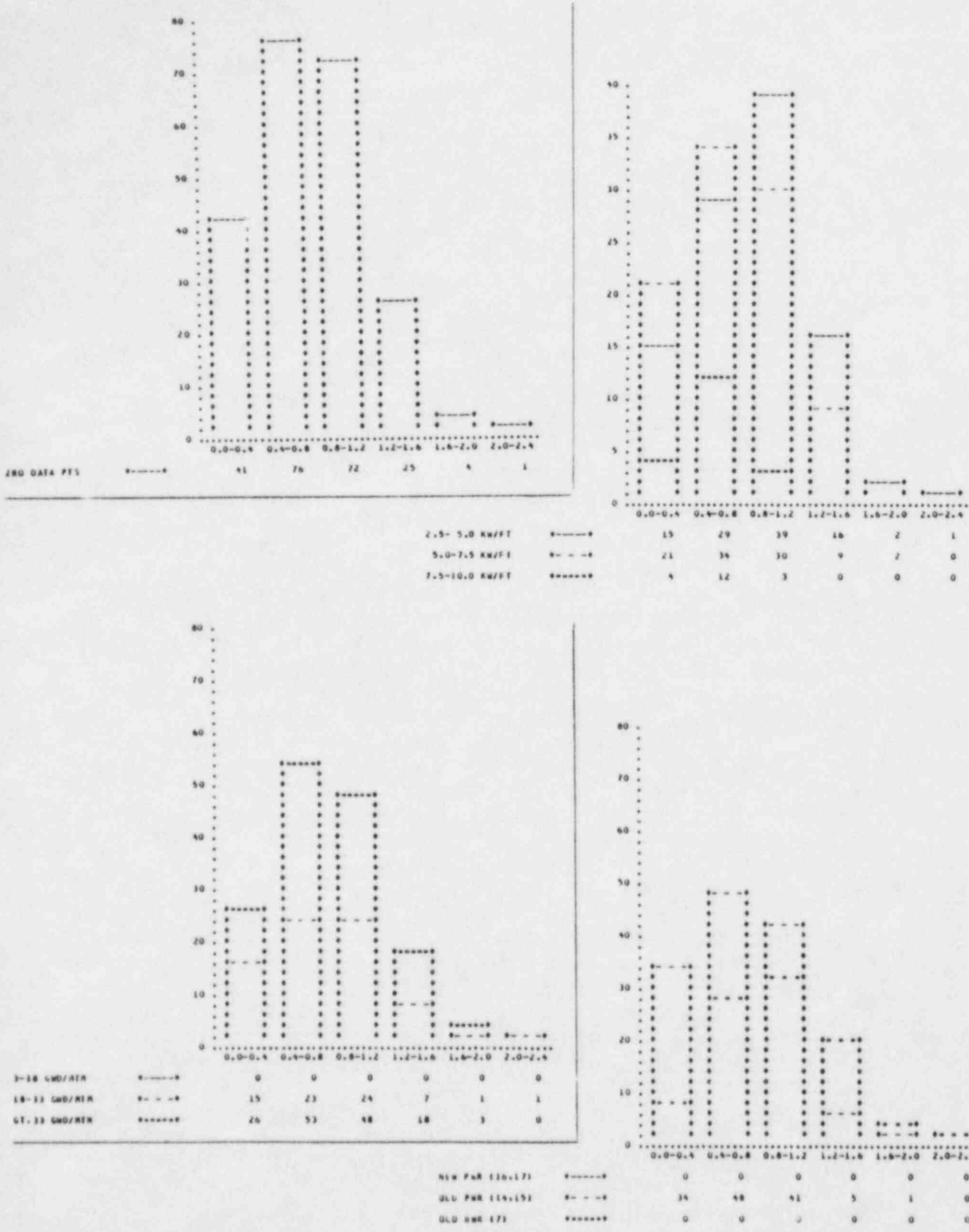


Figure 10: Cladding Surface Corrosion Data Frequency Versus Data Range with and without Power, Burnup, and Design distinctions

4.2 Data Response

Figures 11 through 17 present the data response characteristics for each performance category versus the main operational parameters, power and burnup. For all the base data points, a design distinction has been made by using different symbols for BWR (X) and PWR (□) fuel types. Independent comparison data curves are provided for qualifying the base data in which case the plotting symbols indicate reference numbers. As stated previously in this section, the data analysis objective is to present the data and evaluate its consistency with engineering judgement and independently reported data. The results of the data response evaluation are summarized below.

As was the case for Phase 1 results, the indicated burnup effect on fission gas release (Figure 11) is consistent with the "threshold" theory; namely, either low or high gas release can occur at any burnup depending on whether or not threshold diffusion (temperature) and/or as-built fuel microstructure conditions are met. High release (>10%) data points below 40 GWD/MTM represent unpressurized rods with densifying fuel; high release comparison curves below 40 GWD/MTM reflect either high open porosity or enhanced diffusion and restructuring conditions. Otherwise, the gas release ranges between a few tenths of a percent to a few percent. The observed release can also be either low or high at burnups greater than 40 GWD/MTM. Again, the low release data corresponds with those curves representing lower temperature (<1200°C) operation or stable fuel microstructures with higher gas retention properties. The high release data and comparison curves above 40 GWD/MTM are associated with either unpressurized rods or relatively high power operation (8-12 Kw/ft).

The power effect on fission gas release shown by the data in Figure 11 is consistent with both the comparison curves and the previous discussion of diffusion effects. As a result, the rod cycle average power range between 4 and 9 Kw/ft can be characterized by either low or high gas release fractions. The release at any power level will depend on rod internal heat transfer conditions and the disposition of gas in the fuel relative to diffusion, trapping, and release regions.

As previously seen in both the Phase 1 and current data distribution results, the internal gas helium fraction responses in Figure 12 exhibit the same sort of threshold behavior as the gas release data in Figure 11. In this case, the helium fraction is either greater than 80% (low gas release) or less than 20% (high gas release), regardless

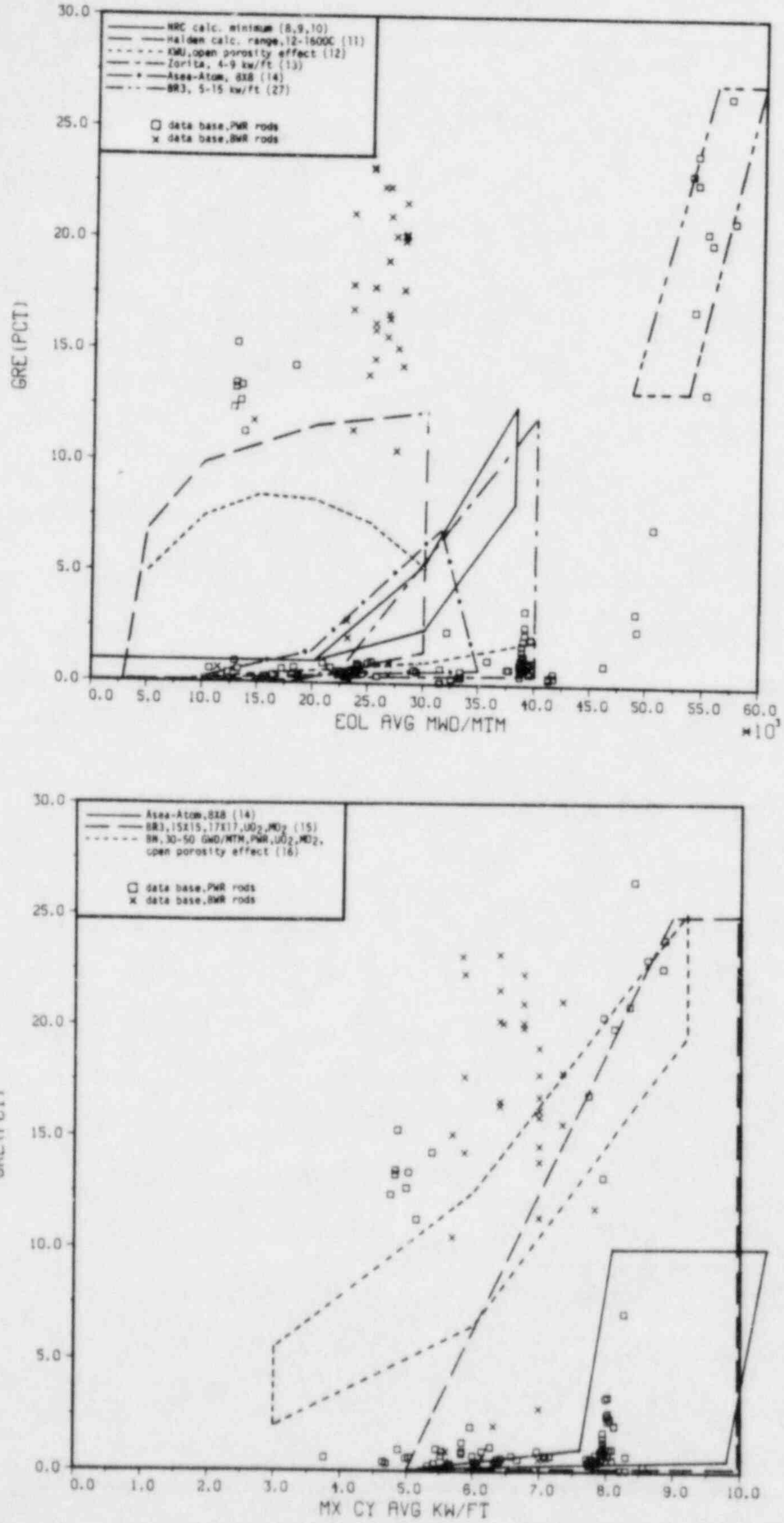


Figure 11: Fission Gas Release Fraction Versus Burnup and Power

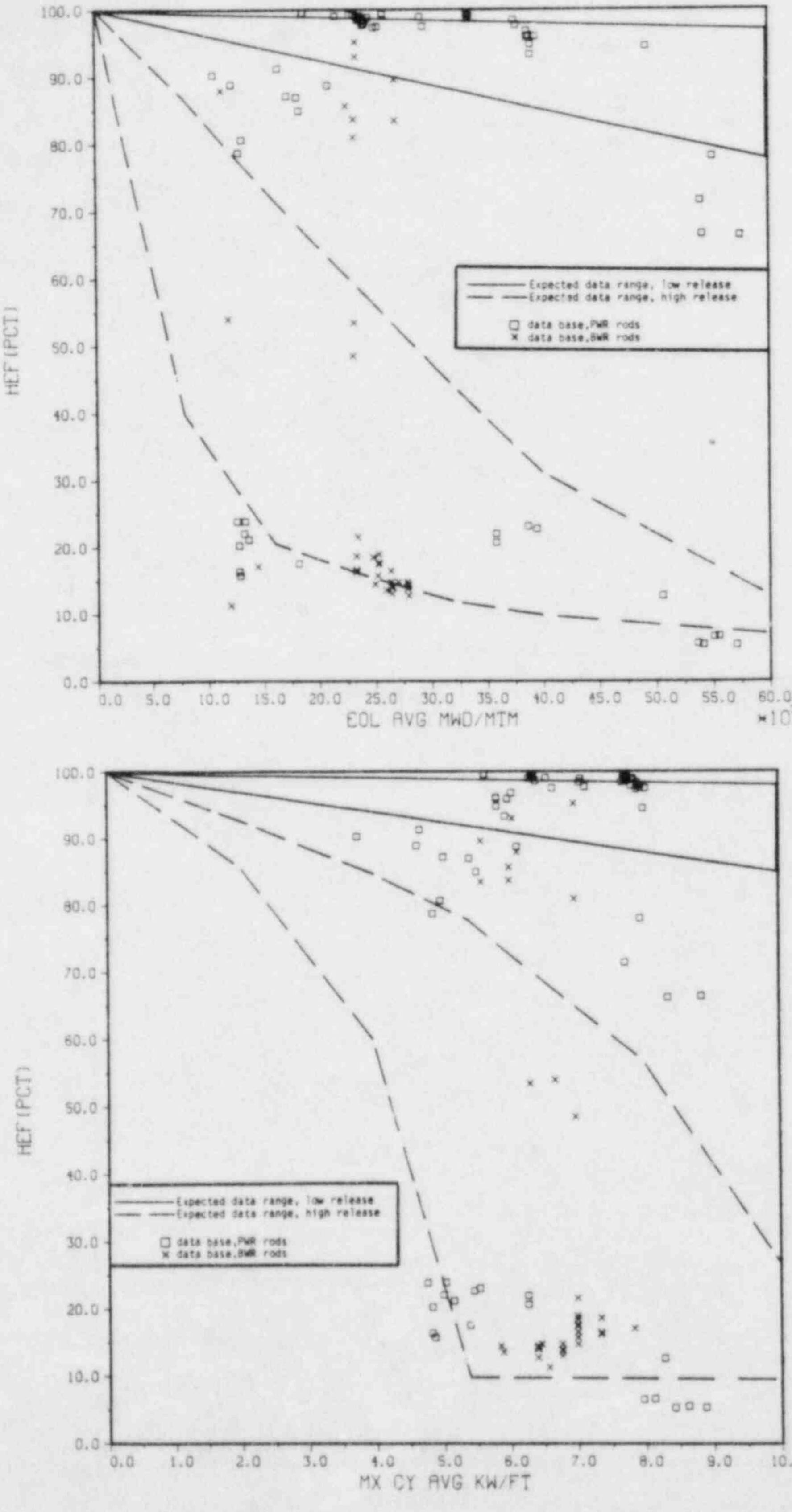


Figure 12: Internal Gas Helium Fraction Verus Burnup and Power

of power or burnup. The helium fraction starts out and remains high, unless threshold diffusion or microstructure conditions are met, as a result of which, low helium fractions will be maintained thereafter. The comparison curves are only included for perspective, since these are based on deduction and qualitative trends, rather than independent data sources.

Figure 13 shows the clad hoop strain data plotted versus burnup and power. This is the largest sample size (1900 points) considered in the present campaign. Consistent with reported Phase 1 results, the observed burnup trends agree with the comparison curves in several key respects; namely,

1. The minimum cladding creep down amounts tend to be associated with BWR conditions as expected.

2. Prepressurization level strongly affects creep down for the PWR rods.

3. The maximum creep down corresponds to older, more densification prone fuel types.

4. Creep down can be reversed at higher burnups as fuel swelling leads to sustained gap closure.

As a result of higher burnup levels, the Phase 2 data sample shows more coupling between the clad hoop stran and fuel swelling behavior.

The power effect on clad hoop strain indicates a relative lack of hard gap closure effects in the Phase 2 data sample. Most of the data occupy the range between 5 and 9 Kw/ft. The fact that more negative strains correspond to power levels above 5 Kw/ft dues not reflect the influence of power, but rather the fact that higher powers were experienced during the earliest (primary creepdown) cycles for most of these rods. A wider range of strains is observed as power increases, which is consistent with expected scatter in gap closure effects.

The cladding elongation data responses are presented in Figure 14. Comparing power and burnup effects indicates that the current data sample is governed by stress free irradiation growth. With the exception of the highest burnup (>50 GWD/MTU) data, the indicated burnup response is consistent with the comparison curves for both BWR and PWR conditions. The highest burnup data relate to Zorita rods, which accumulated their high burnups in a relatively short time (low fluence), and which may have experienced some rod shortening due to tensile hoop stresses building-up late in life. The apparent insensitivity of clad axial strain to power is inconclusive, but

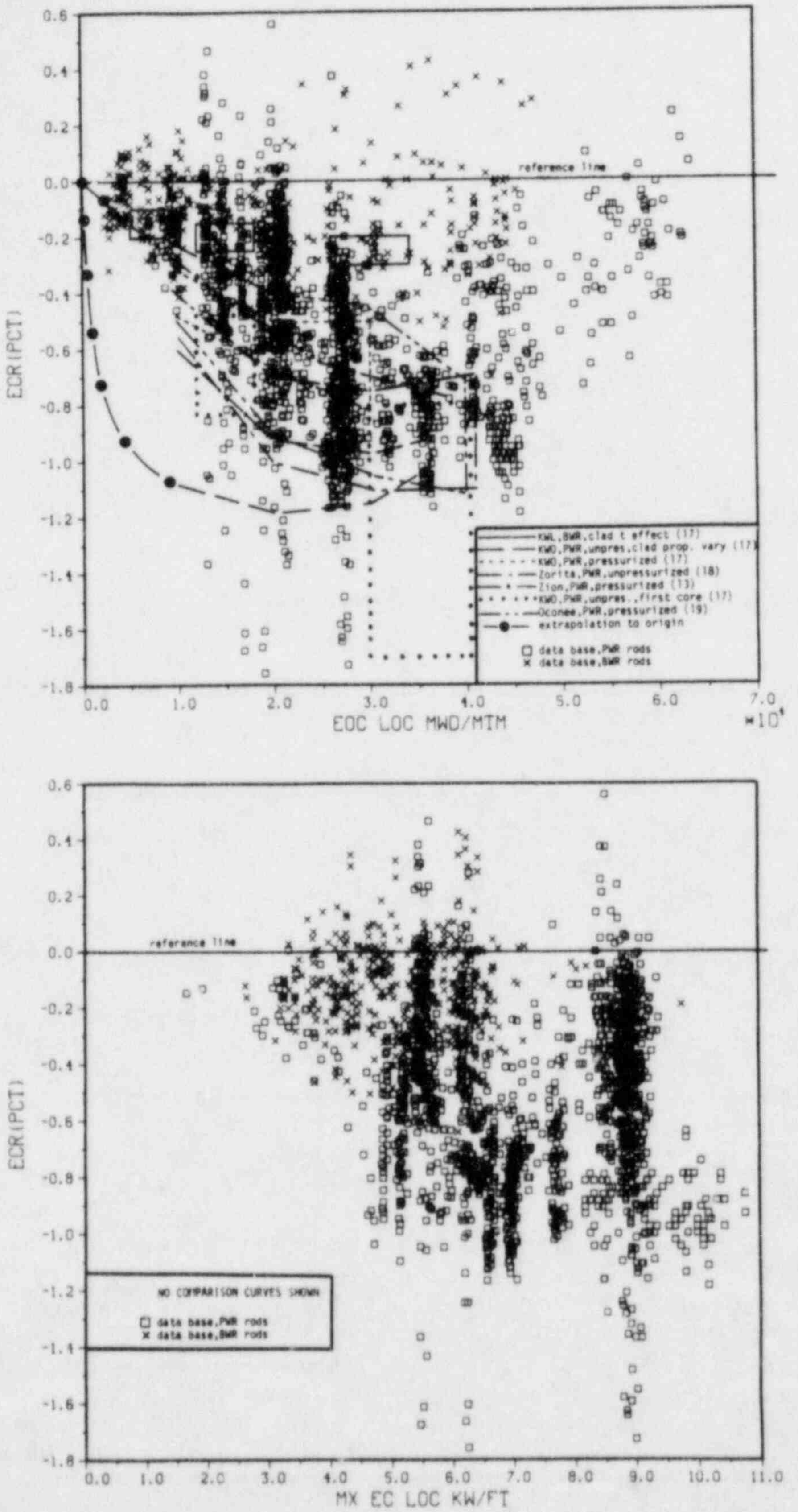


Figure 13: Cladding Hoop Strain Versus Burnup and Power

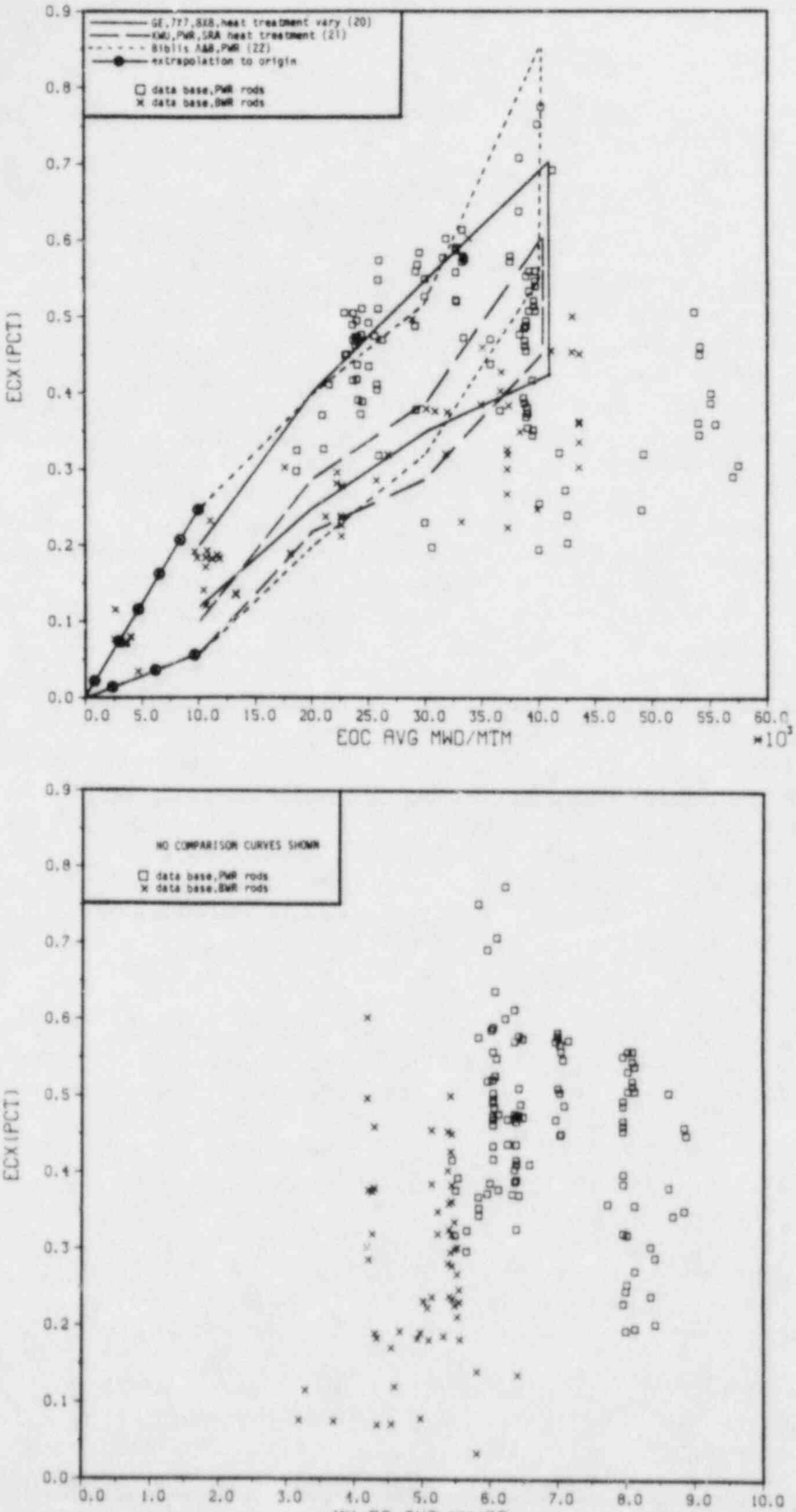


Figure 14: Cladding Axial Strain Versus Burnup and Power

seems to reflect a relative lack of hard PCI effects for the indicated power range.

The fuel axial elongation data are plotted versus burnup and power in Figure 15. Based on the comparison curves, the burnup data response is consistent with expected fuel densification and swelling mechanisms at moderate power conditions. Densification effects are seen to be concentrated during the first several thousand MWD/MTM. The amount of initial densification varies greatly since this depends on fuel fabrication parameters like porosity size distribution or sintering temperature. After the densification rate slows down, a point is reached where swelling accomodation has filled the fuel porosity. Subsequent burnup is accompanied by positive fuel expansion. It should be noted that the Phase 1 fuel elongation data was dominated by an unstable BWR fuel type, which explains many of the larger (<-1%) negative measurements below 30 GWD/MTM. The newer data indicates that much of the initial densification is recovered by 40 GWD/MTM and that the most stable fuel types begin to show positive deformation at relatively low burnups (10 GWD/MTM).

The power effect in Figure 15 is again relatively inconclusive. This indicates that the fuel elongation data sample is more governed by swelling and densification (burnup) mechanisms. It does seem however that a wider range of fuel elongations is observed as power increases. Power levels above 10 Kw/ft or sustained periods of hard gap closure would be required for the fuel length to be significantly affected by negative mechanical deformation.

Relatively few independent comparison curves were available to qualify the relative internal pressure response shown in Figure 16. Also, internal pressure represents the smallest sample size (80 points) considered in the Phase 2 data evaluation. The data response is governed by either fission gas release (high range of measurements) or internal volume changes from densification, swelling, or creep down (low range of measurements). The low and high power code predictions shown are consistent with the indicated data range. The unpressurized rods with either positive thermal feedback or high power are both measured and calculated to have the highest relative pressure change. Some of the low gas release rods are seen to have relative pressure values less than 1 due to fuel densification creating more gas volume. If the gas release remains low, the data indicates that relative internal pressure levels stay below 1.5, even at burnups of 40 GWD/MTM.

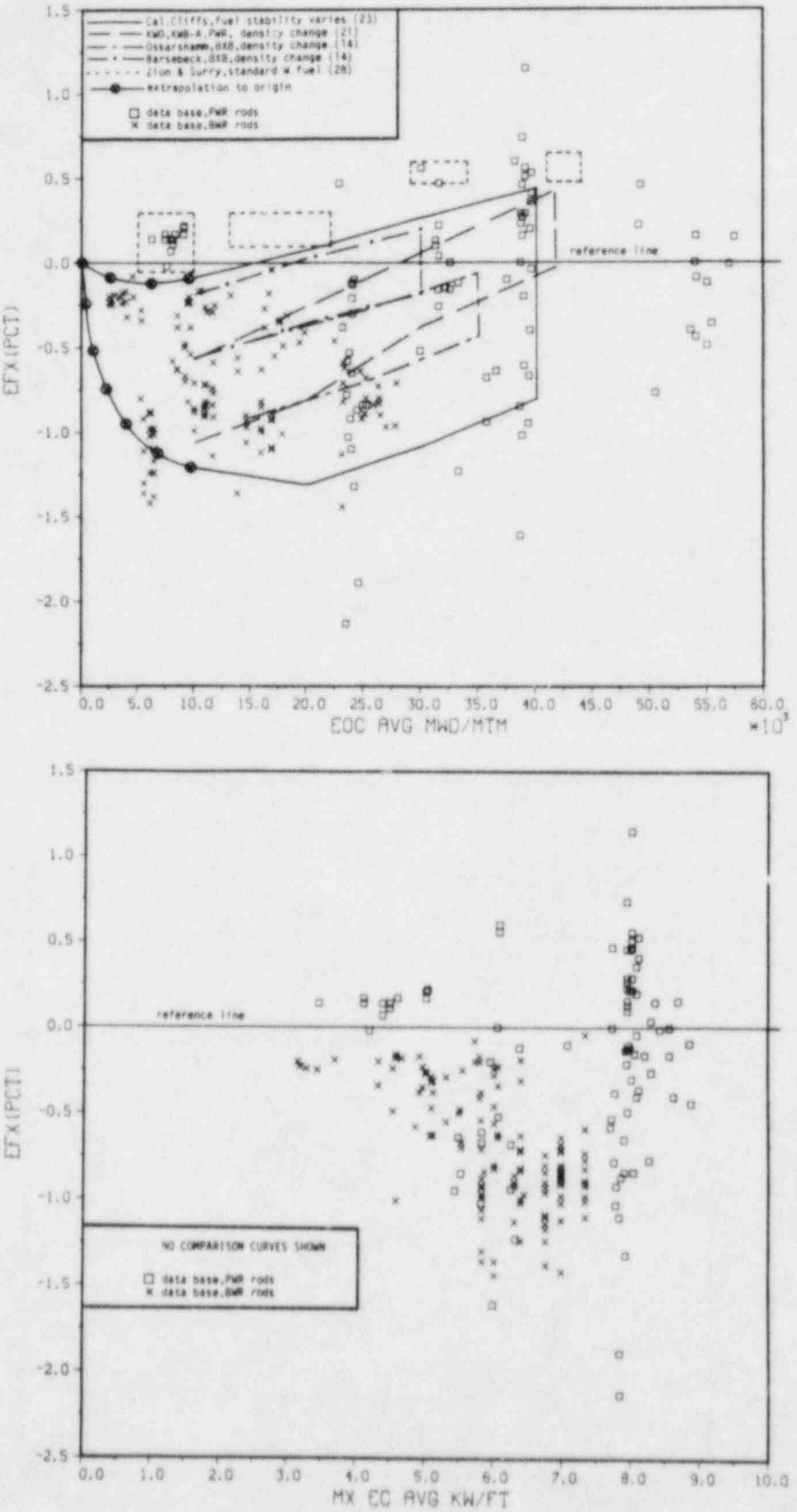


Figure 15: Fuel Axial Elongation Versus Burnup and Power

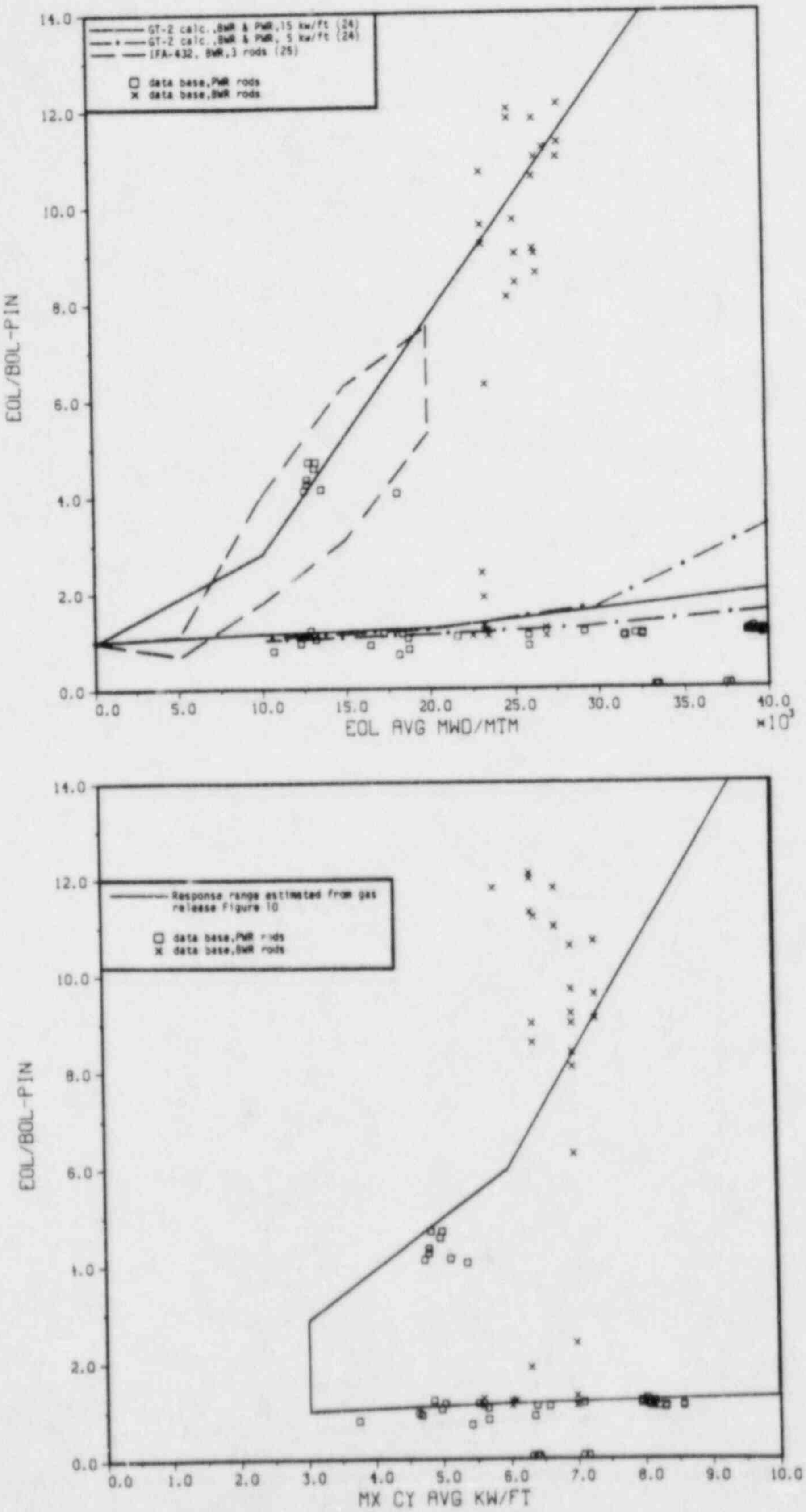


Figure 16: Relative End-of-Life Internal Pressure Versus Burnup and Power

Even though comparison curves were not readily available, the power effect on relative internal pressure is qualitatively consistent with the previously discussed power effect on fission gas release. In other words, either low or high relative pressures can occur for this moderate power range as a result of the threshold nature of gas release mechanisms and associated thermal feedbacks. All of the data points with relative internal pressures above 3.0 correspond to unpressurized rods, ie rods sensitive to gas release regardless of power and burnup. The comparison curves from Figure 11 have been scaled down and overlaid on Figure 16 for illustration purposes. Based on the wide range of the relative pressure data, fission gas release uncertainty can obviously represent much of the designer's margin on internal pressure conditions.

Figure 17 presents the cladding surface corrosion data versus burnup and power. A consistently wide range of burnup effects is seen in both the data and comparison curves. For BWRs and PWRs, this variation reflects the influence of coolant chemistry and crud effects which are governed by system materials and additives. Even though clad surface temperatures are relatively low for BWRs, a large variation in corrosion rate is indicated since the data and comparison curves include both modular and uniform corrosion mechanisms, in addition to coolant chemistry differences. The PWR data and comparison curves represent only uniform corrosion mechanisms.

The influence of power level on corrosion layer thickness is inconclusive in Figure 17. No comparison curves were available in this case. The fact that a wider range of thicknesses is observed below 5.5 Kw/ft is attributable to the BWR data (uniform and nodular data) occupying this power range. The effect of power (temperature and flux level) seems to be masked by variation in coolant chemistry, crud, and corrosion modes.

Review of the above data response characteristics indicates that physically reasonable trends are exhibited by the expanded Phase 2 data sample. This conclusion is based on comparisons between independent documentation of various fuel behavior mechanisms and the relative influence of operational parameters on the performance data sample. As a result, the data acquisition and review results are considered to be useful for application to the high burnup code evaluation purposes outlined in Section 1.

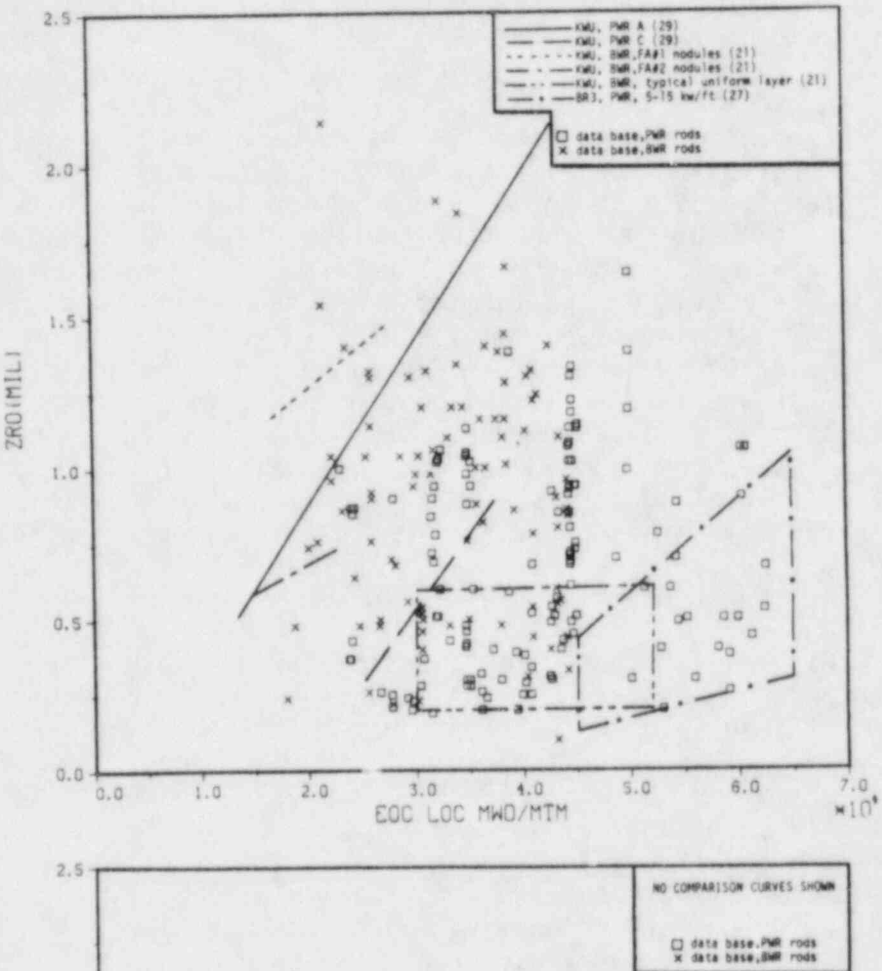


Figure 17: Cladding Surface Corrosion Versus Burnup and Power

5.0 DATA PROCESSING

Previous sections have indicated the relatively large scope of data and code evaluation activities that have been undertaken within the current program. This scope requires systematic processing of both measured and calculated values from many different fuel irradiations and corresponding fuel behavior modeling (FRAPCON) runs. The data processing methods that support this program will be outlined in the following section.

5.1 Data Processing Functions

The basic data processing functions necessary for the current scope of fuel performance code and data evaluation activity include data storage, input, search, reordering, units conversion, calculation of rod power and burnup parameters, merging of data from different files, code input generation, and data output for plotting, listing and code interface purposes.

As seen in the data review and analysis results of Section 3 and 4, special data evaluation functions include determination of:

1. the relative abundance of different types of data,

2. the representation of design and operational conditions in the data sample,

3. the parametric effect of design and operational conditions on the mean data response, and

4. the relative data reproducibility for given ranges of design and operational parameters.

Special code evaluation functions as applied in a companion report (26) include:

1. Comparisons between measured and predicted fuel performance parameters and distributions,

2. diagnosis of design and operational effects on code accuracy,

3. evaluation of the standard deviation of differences between measured and predicted values, and

4. evaluation of the difference between available code and data uncertainty estimates.

Manual data processing functions are also required to meet the program objectives. These functions include,

1. engineering review of fuel surveillance documentation to identify supplemental sources of design, operational, and performance data,

2. repairs and additions to the FPDB "table transfer" results, and

3. engineering review and tabulation of FRAPCON output parameters.

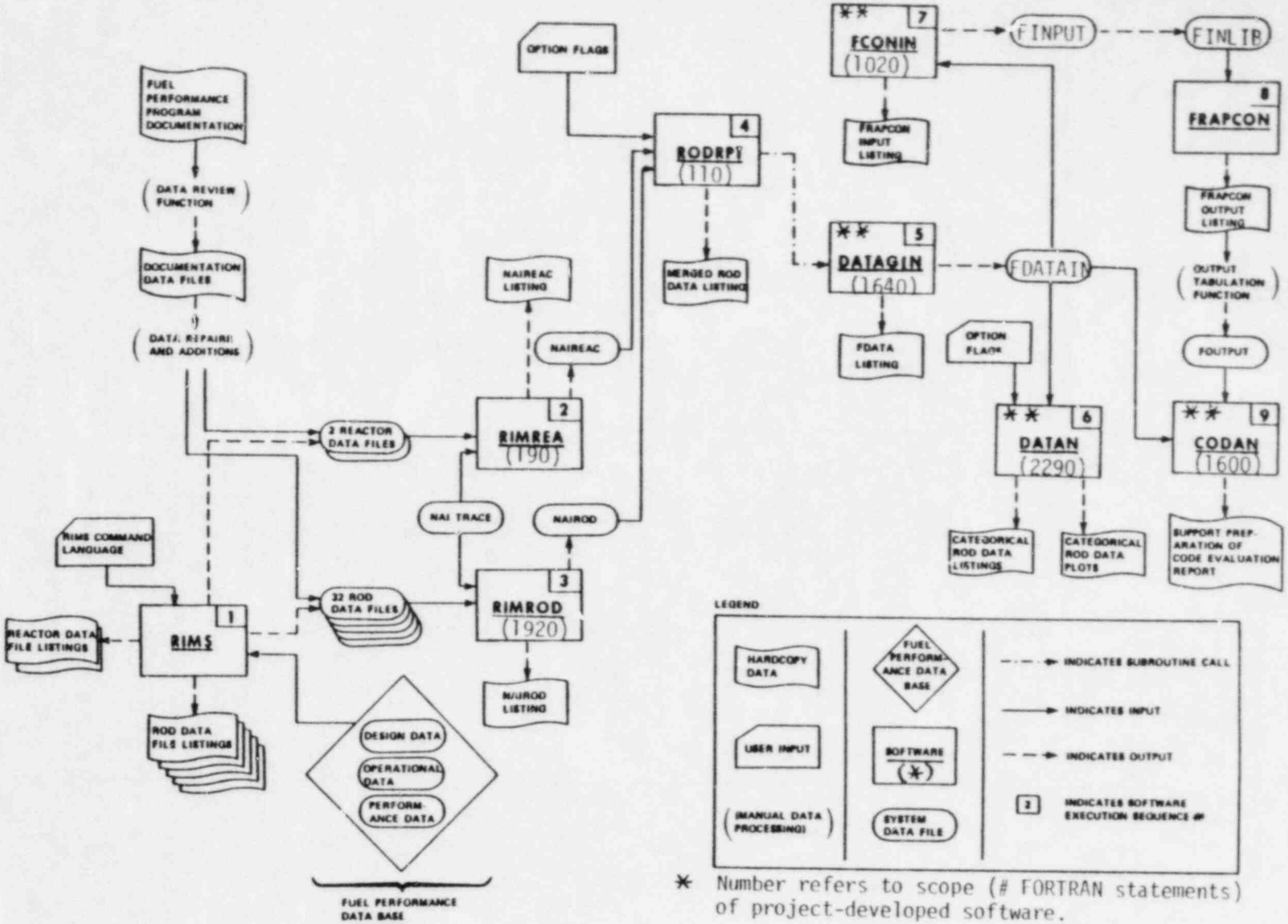
A data processing network was developed to organize the flow of information between the EPRI and DOE fuel surveillance programs, and the data and code evaluation reports generated by the UAI program. The elements of this network are described below.

5.2 Data Processing Network

Figure 18 shows the network that relates the fuel performance data resources (left side of figure) with various data processing elements to support the preparation of data and code evaluation reports (lower right in figure). Different symbols have been used to distinguish between software, data file, hardcopy, user input, and manual data processing elements. The I/O connections and options that exist between the elements have also been indicated. Definition of each software and data file element is provided in Tables 11, 12 and 13 as summarized below.

Basically, the left side of the data processing network in Figure 18 relates to primary data acquisition and creation of the master "ordered" data files, NAIREAC and NAIROD. Primary data are seen to enter the network from either the FPDB or the fuel surveillance program documentation. By the time NAIREAC and NAIROD are generated, primary data which do not relate to the rods of interest (NAI TRACE) has been filtered out of subsequent processing, and the relevant data has been sequentially ordered. The structure of NAIREAC and NAIROD files is the same as previously indicated for the FPDB, except for addition of the rod identification number from Table 4 to each record.

The next key software element of the data processing network, RODRPT, accesses the master data files on a rod by rod basis, and provides this information to one of two paths, i.e., data



* Number refers to scope (# FORTRAN statements) of project-developed software.

** Indicates call to specialized LIBRARY functions (2640 statements) for integration,plots,etc.

Figure 18: DATA PROCESSING NETWORK BY WHICH POWER REACTOR FUEL PERFORMANCE DATA RESOURCES ARE APPLIED TO THE NAI CODE AND DATA EVALUATION PROGRAM

TABLE 11: Summary of Data Evaluation Software

DATA EVALUATION SOFTWARE ELEMENT	FUNCTION
RIMS (Code)	Process RIMS commands to access FPDB tables; select certain fields; "filter out" unneeded records; write resulting output files to printer and transportable mag. tape.
RIMREA (Code)	Read the FPDB reactor files; based on the NAI Trace Table, select and order only the reactor data pertaining to the rods of interest; write this ordered data on NAIREAC file and print for verification
RIMROD (Code)	Read the FPDB rod files; based on the NAI Trace Table, select and order only the rod data pertaining to the rods of interest; write this ordered data on NAIROD file and print for verification
RODRPT (Code)	Read user options,NAIROD and NAIREAC files; merge all data on individual rod basis; call DATAGIN; print merged data for verification
DATAGIN (Sub)	Accept individual rod design, operational and performance data passed from RODRPT; substitute alternate parameters for missing data flags; convert operational history to cycle - based power and burnup parameters; convert performance parameters to FRAPCON units and calculational nodes, convert exam-based performance parameters to cycle-based performance parameters; write, converted and "as-is" parameters to FDATA file and print for verification.
DATAN (Code)	read user options and FDATA file; determine amount of data in each data category, representation of design and operating parameter ranges in data sample, distribution of data for various design and operating parameter ranges, and data trends relative to design and operating parameters. Print/plot results for each data category; upgrade later to include various statistical tests

TABLE 12: Summary of Code Evaluation Software

CODE EVALUATION SOFTWARE ELEMENT	FUNCTION
RODRPT (Code)	Read user options, NAIROD and NAIREAC files; call FCONIN.
FCONIN (Sub)	Accept individual rod design and operational data passed from RODRPT; convert required data to FRAPCON input parameters; write the converted parameters to code input files in acceptable format; print files for verification
FRAPCON (Code)	Fuel behavior model for generation of material performance predictions versus irradiation time
CODAN (Code)	Read FDATA and FOUTPUT files, compare available measurements with predicted values; determine code error relative to design, operational, and performance parameters; compare predicted and measured distributions; determine standard deviation between predicted and measured values; upgrade later to include various statistical tests

TABLE 13: Summary of Code and Data Evaluation System Files

FILE	CONTENTS
FPDB	Repository of fuel rod design, operational, performance, and related data generated by EPRI and DOE irradiation programs
(Reactor Data Files)	Subsets of FPDB Tables 900 and 901 (Appendix I) which were transferred to CYBER processing from the RIMS/FPDB/PRIME system
(Rod Data Files)	Subsets of FPDB Tables 125, 130, 145, 150, 305, 310, 320, 505, 510, 515, 533, 537, 620, 625, 626, 629, 630, 652, and 715 (Appendix I) which were transferred to CYBER processing from the RIMS/FPDB/PRIME system
NAI TRACE	Specialized tracking or identification parameters by which information relative to the data sample is located in the Reactor and Rod Data Files.
NAI REAC	Ordered information from the Reactor files pertaining to each rod in the data sample
NAI ROD	Ordered information from the Rod files pertaining to each rod in the data sample
FDATA	Key design parameters plus power, burnup, and available performance parameters on a cycle by cycle basis for each rod in the data sample
FINPUT	Design and operational parameters in acceptable FRAPCON input format for each rod in the data sample
FOUTPUT	Performance parameter predictions from FRAPCON corresponding to available measurements from FDATA

or code evaluation. RODRPT also merges all of the master data for inspection purposes. A sample of the merged output from RODRPT is shown in Appendix C.

The data evaluation path that leads from RODRPT includes two software elements, DATAGIN and DATAN. DATAGIN is a subroutine of RODRPT which essentially simplifies the "master" operational and performance data to a form (FDATA) consistent with cycle-based data analysis and FRAPCON units and nodalization. Sample output from DATAGIN is provided in Appendix D. DATAN audits the results of DATAGIN for each data category so as to determine sample sizes, data distribution, and engineering trends with respect to design and operational parameters. DATAN produces the plots previously discussed in Sections 3 and 4. An example of the DATAN Output listing is shown in Appendix E.

A companion report (26) addresses the code evaluation aspects of the data processing network shown in Figure 16. Definition of these data processing elements was provided in Table 12.

6.0 REFERENCES

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APPENDIX A

FPDB TABLES AND FIELD NAMES

EMPHASIZED DURING DATA ACQUISITION

Table Name: ASSY_DIM Form No: 715
Table Description: FUEL ASSEMBLY DIMENSION

Parameter	Definition	Units
AN	ASSY NO	
AT	ASSY TYPE	
NOG	NO OF GRIDS	
NOR	NO OF RODS	
RHD	ROD HYDRAULIC DIAM	

Table Name: ASSY_HERM Form No: 844
Table Description: ASSEMBLY HERMETICITY SUMMARY

Parameter	Definition	Units
AN	ASSY NO	
FDT	FAILURE DETERMINATION TIME	DATE_TIME
FFDM	FUEL FAILURE DETERMIN METHOD	
NRF	NO RODS FAILED	
RN	REACTOR NAME	
SAFC	STATUS AND FAILURE CAUSE	
TOM	TIME OF MEASUREMENT	
XAL	X ASSY LOCATION	
YAL	Y ASSY LOCATION	

Table Name: REACTOR Form No: 900
Table Description: REACTOR DESCRIPTION

Parameter	Definition	Units
CIBT	CYCLE IRRADIATION BEGIN TIME	DATE_TIME
CIET	CYCLE IRRADIATION END TIME	DATE_TIME
EPN	EPRI PROJECT NO	
FFTPR	FAST FLUX TO POWER RATIO	NFT/CM2SECKW
NOAIC	NO OF ASSEMBLIES IN CORE	
RCN	REACTOR CYCLE NUMBER	
RN	REACTOR NAME	
RT	REACTOR TYPE	
TACN	TEST ASSY CYCLE NUMBER	

Table Name: PELLET_CHEM Form No. 145
Table Description: PELLET ISOTOPIC, RARE EARTH & CHEMICAL ANALYSIS

Parameter	Definition	Units
H2IP	H2, IN PELLET	CC/G
H2IPE	H2,O IN PE,LLET	PPM
HIPE	H IN PE,LLET	PPM
INDL	INVERSE NEUTRON DIFFUSION LEN	1/CM
N2IP	N2, IN PELLET	CC/G
NIP	N IN PELLET	PPM
PEOTUR	PE,LLET O TO U RATIO	
PLN	PELLET LOT NO	
PSN	PELLET SN,	
U5IP	U235, IN PELLET	W/O

Table Name: PELLET_DIM Form No: 150
Table Description: SINTERED PELLET DIMENSIONS

Parameter	Definition	Units
PBCW	PELLET BOTTOM CHAMFR WIDTH	IN
PCHD	PELLET CENTRAL HOLE DIAMETER	IN
PEL	PE,LLET LENGTH	IN
PLDD	PELLET LOWER DISH DEPTH	IN
PLDDI	PELLET LOWER DISH DI,AMETER	IN
POD	PELLET OUTSIDE DIAMETER	IN
PSN	PELLET SN,	
PTCW	PELLET TOP CHAMFR WIDTH	IN
PTN	PELLET TRAY NO	
PUDD	PELLET UPPER DISH DEPTH	IN
PUDDI	PELLET UPPER DISH DI,AMETER	IN

Table Name: TUBE_COMP Form No: 305
Table Description: COMPOSITION & PHYSICAL PROPERTIES OF ZIRC TUBING

Parameter	Definition	Units
FAT	FINAL ANNEALING TEMPERATURE	DEG_F
OST	OUTSIDE SURFACE TREATMENT	
TAN	TEXTURE AN,GLE	DEGREE
TISR	TUBE ID SURFACE ROUGHNESS	UIN(AA)
TLN	TUBE LOT NO	
TM	TUBE MATERIAL	
TS	TUBE SN	

Table Name: TRACEABILITY Form No: 010
Table Description: MAJOR COMPONENTS TRACEABILITY

Parameter	Description	Units
AN	ASSY NO	
FRGN	FUEL ROD GROUP NO	
FRLN	FUEL ROD LOT NO	
FRS	FUEL ROD SN	
NOCI	NO OF CYCLES IRRADIATED	
PLN	PELLET LOT NO	
PSN	PELLET SN	
PTN	PELLET TRAY NO	
RN	REACTOR NAME	
TLN	TUBE LOT NO	
TS	TUBE SN	

Table Name: PELLET_SINT Form No: 125
Table Description: PELLET SINTERING HISTORY

Parameter	Description	Units
ABDI	ASYMPTOTIC BULK DENSITY INC	G/CC
CFT	CO2 FURNACE TEMPERATURE	DEG_F
DBC	DENSIFICATION BURNUP CONSTANT	MWD/MTM
HFT	H2 FURNACE TEMPERATURE	DEG_F
PSN	PELLET SN	
PTN	PELLET TRAY NO	
RBD	RESINTERED BULK DENSITY	G/CC

Table Name: PELLET_FAB Form No: 130
Table Description: SINTERED PELLET FABRICATION HISTORY

Parameter	Description	Units
CSR	CYLINDRICAL SURFACE ROUGHNESS	UIN(AA)
DT	DRYING TEMPERATURE	DEG_F
GS	GRAIN SIZE	MICRON
OPO	OPEN PO,ROSITY	%
PBD	PELLET BULK DENSITY	G/CC
PGD	PELLET GEOMETRIC DENSITY	G/CC
PS	PORE SIZE	MICRON
PSN	PELLET SN	
PTN	PELLET TRAY NO	

Table Name: CLAD_DIM Form No: 310
Table Description: DESIGN CLADDING DIMENSIONS

Parameter	Definition	Units
FRS	FUEL ROD SN	
TE	TUBE ECCENTRICITY	MILS
TID	TUBE INSIDE DIAMETER	IN
TL	TUBE LENGTH	IN
TLN	TUBE LOT NO	
TOD	TUBE OUTSIDE DIAMETER	IN
TOV	TUBE OV,ALITY	MILS
TS	TUBE SN	
TWT	TUBE WALL THICKNESS	IN

Table Name: TUBE_MECH Form No: 320
Table Description: PREIRRADIATION ZR TUBING MECHANICAL PROPERTIES

Parameter	Definition	Units
HAPP	HOT ANISOTROPY PARM P	
HAPR	HOT ANISOTROPY PARM R	
HBU	HOT BURST UTS	KSI
HBYS	HOT BURST YIELD STRENGTH	KSI
HU	HOT UTS	KSI
HYS	HOT YIELD STRENGTH	KSI
TLN	TUBE LOT NO	
TS	TUBE SN	
TTT	TUBING TEST TEMP	DEG_F

Table Name: ROD_PARTS Form No: 500
Table Description: PARTS LIST FOR AS BUILT ASSEMBLED FUEL RODS

Parameter	Definition	Units
FRLN	FUEL ROD LOT NO	
FRS	FUEL ROD SN	
ILN	ITEM LOT NO	
IM	ITEM MATERIAL	
IMF	ITEM MF,R	
IS	ITEM SN	
ITD	IT,EM DESCRIPTION	

Table Name: ROD_PRESS Form No: 505
Table Description: FUEL ROD PRESSURIZATION PROCESS

Parameter	Definition	Units
ARIFGA	AR, IN FILL GA,S	VOLUME_%
BP	BACKFILLING PRESSURE	PSI
BT	BACKFILLING TEMPERATURE	DEG_F
FGLN	FILL GAS LOT NO	
FGS	FILL GAS SN	
FRLN	FUEL ROD LOT NO	
FRS	FUEL ROD SN	
GET	GE,T,TER	
HEIFGA	HE, IN FILL GA,S	VOLUME_%
NIFGA	N IN FILL GA,S	VOLUME_%

Table Name: ROD_DIM Form No: 510
Table Description: FUEL ROD COMPONENT DIMENSIONS

Parameter	Definition	Units
AFL	ACTIVE FUEL LENGTH	IN
FRLN	FUEL ROD LOT NO	
FRS	FUEL ROD SN	
LECIL	LOWER END CAP INSERTED LENGTH	IN
LSDL	LOWER SPACER DISK LENGTH	IN
PL	PLENUM LENGTH	IN
PV	PLENUM VOLUME	IN3
ROL	ROD OVERALL LENGTH	IN
TFL	TOTAL FUEL LENGTH	IN
UECIL	UPPER END CAP INSERTED LENGTH	IN
USDL	UPPER SPACER DISK LENGTH	IN

Table Name: GAS_IMP Form No: 515
Table Description: FILL GAS IMPURITY ANALYSIS

Parameter	Definition	Units
ARIG	AR, IN GAS	PPM
FGLN	FILL GAS LOT NO	
FGS	FILL GAS SN	
H2IG	H2,O IN GAS	PPM
HEIG	HE, IN GAS	PPM
HIG	H2, IN GAS	PPM
MIG	METHANE IN GAS	PPM
NIG	N2 IN GAS	PPM
OIG	O2 IN GAS	PPM

Table Name: ROD_HIST Form No: 530
Table Description: FUEL ROD IRRADIATION HISTORY

Parameter	Definition	Units
AN	ASSY NO	
CAP	COOLANT AVERAGE PRESSURE	ATM
FRS	FUEL ROD SN	
FSL	FUEL STACK LENGTH	IN
IT	IRRADIATION TIME	DATE_TIME
PSTS	POWER SHAPE TIME STEP	
RAE	ROD AXIAL ELONGATION	%
RN	REACTOR NAME	
RPB	ROD PEAK BURNUP	MWD/MTM
RPP	ROD PEAK POWER	KW/FT
RPTAP	ROD PEAK TO AVERAGE POWER	

Table Name: PFACTORS Form No: 533
Table Description: AXIAL & RADIAL POWER PEAKING FACTORS

Parameter	Definition	Units
AN	ASSY NO	
FRGN	FUEL ROD GROUP NO	
FRS	FUEL ROD SN	
IT	IRRADIATION TIME	DATE_TIME
NASP	NORMALIZED AXIAL SECTION POWER	PEAK=1
PRSP	PEAK RATED SECTION POWER	KW/FT
PSTS	POWER SHAPE TIME STEP	
RN	REACTOR NAME	

Table Name: BPROFIL Form No: 537
Table Description: FUEL ROD AXIAL SECTION BURNUP PROFILES

Parameter	Definition	Units
AN	ASSY NO	
FRGN	FUEL ROD GROUP NO	
FRS	FUEL ROD SN	
IT	IRRADIATION TIME	DATE_TIME
PB	PEAK BURNUP	MWD/MTM
RN	REACTOR NAME	
SRB	SECTION RELATIVE BURNUP	PEAK=1

Table Name: TRACE_INDEX Form No: 620
Table Description: INDEX OF ROD DIMENSIONAL TRACES

Parameter	Definition	Units
ARL	AXIAL REFERENCE LOCATION	
E1IT	EXAM 1 IRRADIATION TIME	DATE_TIME
E1TOM	EXAM 1 TIME OF MEASUREMENT	
E2IT	EXAM 2 IRRADIATION TIME	DATE_TIME
E2TOM	EXAM 2 TIME OF MEASUREMENT	
E3IT	EXAM 3 IRRADIATION TIME	DATE_TIME
E3TOM	EXAM 3 TIME OF MEASUREMENT	
FRS	FUEL ROD SN	
NOLPT	NO OF LINEAR PROFIL TRACES	
NOSPT	NO OF SPIRAL PROFIL TRACES	
NOTH	NO OF TH,ETAS	
T1	THETA 1	DEGREE
T2	THETA 2	DEGREE
T3	THETA 3	DEGREE
T4	THETA 4	DEGREE
TLN	TUBE LOT NO	

Table Name: ROD_PROFIL1 Form No: 625
Table Description: ROD PROFILOMETRY (1 THETA)

Parameter	Definition	Units
ADFR	AXIAL DISTANCE FROM REFERENCE	IN
E1OD101	EXAM 1 OUTER DIAMETER 1 OF 1	IN
E2OD101	EXAM 2 OUTER DIAMETER 1 OF 1	IN
E3OD101	EXAM 3 OUTER DIAMETER 1 OF 1	IN
FRS	FUEL ROD SN	
TLN	TUBE LOT NO	

Table Name: ROD_PROFIL2 Form No: 626
Table Description: ROD PROFILOMETRY (2 THETA)

Parameter	Definition	Units
ADFR	AXIAL DISTANCE FROM REFERENCE	IN
E1OD102	EXAM 1 OUTER DIAMETER 1 OF 2	IN
E1OD202	EXAM 1 OUTER DIAMETER 2 OF 2	IN
E2OD102	EXAM 2 OUTER DIAMETER 1 OF 2	IN
E2OD202	EXAM 2 OUTER DIAMETER 2 OF 2	IN
E3OD102	EXAM 3 OUTER DIAMETER 1 OF 2	IN
E3OD202	EXAM 3 OUTER DIAMETER 2 OF 2	IN
FRS	FUEL ROD SN	
TLN	TUBE LOT NO	

Table Name: ROD_PROFIL3 Form No: 627
Table Description: ROD PROFILOMETRY (3 THETA)

Parameter	Definition	Units
ADFR	AXIAL DISTANCE FROM REFERENCE	IN
E1OD103	EXAM 1 OUTER DIAMETER 1 OF 3	IN
E1OD203	EXAM 1 OUTER DIAMETER 2 OF 3	IN
E1OD303	EXAM 1 OUTER DIAMETER 3 OF 3	IN
E2OD103	EXAM 2 OUTER DIAMETER 1 OF 3	IN
E2OD203	EXAM 2 OUTER DIAMETER 2 OF 3	IN
E2OD303	EXAM 2 OUTER DIAMETER 3 OF 3	IN
E3OD103	EXAM 3 OUTER DIAMETER 1 OF 3	IN
E3OD203	EXAM 3 OUTER DIAMETER 2 OF 3	IN
E3OD303	EXAM 3 OUTER DIAMETER 3 OF 3	IN
FRS	FUEL ROD SN	
TLN	TUBE LOT NO	

Table Name: ROD_PROFIL4 Form No: 628
Table Description: ROD PROFILOMETRY (4 THETA)

Parameter	Definition	Units
ADFR	AXIAL DISTANCE FROM REFERENCE	IN
E1OD104	EXAM 1 OUTER DIAMETER 1 OF 4	IN
E1OD204	EXAM 1 OUTER DIAMETER 2 OF 4	IN
E1OD304	EXAM 1 OUTER DIAMETER 3 OF 4	IN
E1OD404	EXAM 1 OUTER DIAMETER 4 OF 4	IN
E2OD104	EXAM 2 OUTER DIAMETER 1 OF 4	IN
E2OD204	EXAM 2 OUTER DIAMETER 2 OF 4	IN
E2OD304	EXAM 2 OUTER DIAMETER 3 OF 4	IN
E2OD404	EXAM 2 OUTER DIAMETER 4 OF 4	IN
E3OD104	EXAM 3 OUTER DIAMETER 1 OF 4	IN
E3OD204	EXAM 3 OUTER DIAMETER 2 OF 4	IN
E3OD304	EXAM 3 OUTER DIAMETER 3 OF 4	IN
E3OD404	EXAM 3 OUTER DIAMETER 4 OF 4	IN
FRS	FUEL ROD SN	
TLN	TUBE LOT NO	

Table Name: ROD_SPIRAL Form No: 629
Table Description: ROD SPIRAL PROFILOMETRY

Parameter	Definition	Units
ADFR	AXIAL DISTANCE FROM REFERENCE	IN
E1SO102	EXAM 1 SPIRAL OD 1 OF 2	IN
E1SO202	EXAM 1 SPIRAL OD 2 OF 2	IN
E2SO102	EXAM 2 SPIRAL OD 1 OF 2	IN
E2SO202	EXAM 2 SPIRAL OD 2 OF 2	IN
E3SO102	EXAM 3 SPIRAL OD 1 OF 2	IN
E3SO202	EXAM 3 SPIRAL OD 2 OF 2	IN
FRS	FUEL ROD SN	
TLN	TUBE LOT NO	

Table Name: ROD_LENGTH Form No: 630
Table Description: FUEL ROD LENGTH

Parameter	Definition	Units
AN	ASSY NO	
FRS	FUEL ROD SN	
IT	IRRADIATION TIME	DATE_TIME
RN	REACTOR NAME	
TOM	TIME OF MEASUREMENT	
XRL	X ROD LOCATION	
YRL	Y ROD LOCATION	
FRL	FUEL ROD LENGTH	IN

Table Name: ROD_HERM Form No: 644
Table Description: FUEL ROD HERMETICITY SUMMARY

Parameter	Definition	Units
FDT	FAILURE DETERMINATION TIME	DATE_TIME
FFDM	FUEL FAILURE DETERMIN METHOD	
FRS	FUEL ROD SN	
RN	REACTOR NAME	
SAFC	STATUS AND FAILURE CAUSE	
TOM	TIME OF MEASUREMENT	
XFRL	X FUEL ROD LOCATION	
YFRL	Y FUEL ROD LOCATION	

Table Name: ROD_GAS Form No: 652
Table Description: FUEL ROD FISSION GAS ANALYSIS

Parameter	Definition	Units
AN	ASSY NO	
ARIFG	AR, IN FISSION GAS	VOLUME_%
C1R	CALCULATED 100% RELEASE	CC@STP
C2IFG	CO2, IN FISSION GAS	VOLUME_%
C4IFG	CH4, IN FISSION GAS	VOLUME_%
FRS	FUEL ROD SN	
GAPF	GAS ATOMS PER FISSION	
GP	GAS PRESSURE	ATM
H2IFG	H2, IN FISSION GAS	VOLUME_%
HEIFG	HE, IN FISSION GAS	VOLUME_%
HOIFG	H2O, IN FISSION GAS	VOLUME_%
KRIFG	KR, IN FISSION GAS	VOLUME_%
M1R	MEASURED 100% RELEASE	CC@STP
N2IFG	N2, IN FISSION GAS	VOLUME_%
O2IFG	O2, IN FISSION GAS	VOLUME_%
PFGR	PERCENT FISSION GAS RELEASE	%
VFGR	VOLUME FISSION GAS RELEASE	CC@STP
XEIFG	XE, IN FISSION GAS	VOLUME_%

Table Name: ROD_MET Form No: 672
Table Description: POST IRR FUEL ROD METALLOGRAPHY

Parameter	Definition	Units
COG	CO,LUMNAR GRAINS	
EG	EQUIAXED GRAINS	
FCB	FUEL CLADDING BONDING	
FRS	FUEL ROD SN	
GA	GA,P	
HD	HYDRIDE DISTRIBUTION	
HYP	HY,DRIDE PRESENT	
OLOID	OXIDE LAYER ON INSIDE DIAMETER	
ROCC	RADIAL OR CIRCUM CRACK	

Table Name: ROD_SEM Form No: 676
Table Description: POST IRR FUEL ROD SEM SAMPLE ID & MATERIAL DENSITY

ALOAF	AXIAL LOC OF APPARENT FEATURE	IN
FD	FUEL DENSITY	G/CC
FRS	FUEL ROD SN	
RLOAF	RADIAL LOC OF APPARENT FEATURE	
SC	SEM COMMENTS	

Table Name: OXIDE_MET Form No: 690
Table Description: OXIDE THICKNESS FROM METALLOGRAPHIC TECHNIQUES

Parameter	Definition	Units
AB	AVERAGE BURNUP	MWD/MTM
ALC1	AVERAGE LHGR CYCLE 1	W/CM
ALC2	AVERAGE LHGR CYCLE 2	W/CM
ALC3	AVERAGE LHGR CYCLE 3	W/CM
ALC4	AVERAGE LHGR CYCLE 4	W/CM
AN	ASSY NO	
APFB	AXIAL POSITION FROM BOTTOM	CM
FRS	FUEL ROD SN	
GRP	GR,ID POSITION	
MAOT	MA,XIMUM OXIDE THICKNESS	MICRON
MIOT	MI,NIMUM OXIDE THICKNESS	MICRON
MOT	MEAN OXIDE THICKNESS	MICRON
NP	NODULES PRESENT	
RN	REACTOR NAME	
ST	SURFACE TREATMENT	

Table Name: INDEX_OXIDE Form No: 692
Table Description: INDEX FOR EDDY CURRENT OXIDE THICKNESS

Parameter	Definition	Units
AB	AVERAGE BURNUP	MWD/MTM
ALC1	AVERAGE LHGR CYCLE 1	W/CM
ALC2	AVERAGE LHGR CYCLE 2	W/CM
ALC3	AVERAGE LHGR CYCLE 3	W/CM
ALC4	AVERAGE LHGR CYCLE 4	W/CM
AN	ASSY NO	
FRS	FUEL ROD SN	
RN	REACTOR NAME	
ST	SURFACE TREATMENT	

Table Name: OXIDE_EC Form No: 694
Table Description: OXIDE THICKNESS FROM EDDY CURRENT TECHNIQUE

Parameter	Definition	Units
AN	ASSY NO	
APFRB	AXIAL POSITION FROM ROD BOTTOM	CM
FRS	FUEL ROD SN	
O1T	ORIENTATION 1 THICKNESS	MICRON
O2T	ORIENTATION 2 THICKNESS	MICRON
O3T	ORIENTATION 3 THICKNESS	MICRON
O4T	ORIENTATION 4 THICKNESS	MICRON

Table Name: CORE_HIST Form No: 901
Table Description: CORE IRRADIATION HISTORY

Parameter	Definition	Units
CCIT	CORE COOLANT INLET TEMP	DEG_F
CCP	CORE COOLANT PRESSURE	ATM
CCV	CORE COOLANT VELOCITY	FT/SEC
IT	IRRADIATION TIME	DATE_TIME
PSTS	POWER SHAPE TIME STEP	
REP	RE,ACTOR POWER	RATED=1
RN	REACTOR NAME	

Table Name: CORE_CHEM Form No: 915
Table Description: CORE COOLANT CHEMISTRY

Parameter	Definition	Units
BAIC	BORIC ACID IN COOLANT	PPM_B
CICO	CO2 IN CO,OLANT	PPM
CLIC	CL, IN COOLANT	PPM
CP	COOLANT PH	
FIC	F IN COOLANT	PPM
HICO	H IN CO,OLANT	CC@STP/KGH2O
HYIC	HY,DRAZENE IN COOLANT	PPM
IT	IRRADIATION TIME	DATE_TIME
OIC	O IN COOLANT	PPM
RN	REACTOR NAME	
TSS	TOTAL SOLIDS SUSPENDED	PPM

APPENDIX B

LISTING OF NAI TRACE TABLE FOR

THE 123 ROD (PHASE 1)

AND 170 ROD (PHASE 2)

DATA SAMPLES

PHASE 1 TRACE PARAMETERS

(Rods 1-123)

NROD	RJ	DRC	AN	RN	NOCI	FRGN	FRLN	FRS	TLN	TS	PLN	PSN	PTN	SBN
TRACE(1)		113	CC1-BT03	CALVERT CLIFFS 1	4	-201	CC1-01	CC1-10	CC1-01	-201	CC1-NP	NAI-PSN-5	CC1-NP	CC1-NP
TRACE(2)		114	CC1-BT03	CALVERT CLIFFS 1	3	-201	CC1-01	CC1-12	CC1-01	-201	CC1-NP	NAI-PSN-5	CC1-NP	CC1-NP
TRACE(3)		115	CC1-BT03	CALVERT CLIFFS 1	4	-201	CC1-07	CC1-24	CC1-01	-201	CC1-T2	NAI-PSN-6	CC1-T2	CC1-T2

TRACE(4)	116CC1-BT03	CALVERT CLIFFS 1	4-201	CC1-07	CC1-26	CC1-01	-201		
						CC1-T2	NAT-PSN-6	CC1-T2	CC1-T2
TRACE(5)	117CC1-BT03	CALVERT CLIFFS 1	4-201	CC1-08	CC1-34	CC1-01	-201		
						CC1-T2	CC1-323	CC1-T2	CC1-T2
						CC1-T2	CC1-324	CC1-T2	CC1-T2
						CC1-T2	CC1-325	CC1-T2	CC1-T2
						CC1-T2	CC1-326	CC1-T2	CC1-T2
						CC1-T2	CC1-352	CC1-T2	CC1-T2
						CC1-T2	CC1-353	CC1-T2	CC1-T2
						CC1-T2	CC1-354	CC1-T2	CC1-T2
						CC1-T2	CC1-355	CC1-T2	CC1-T2
TRACE(6)	118CC1-BT03	CALVERT CLIFFS 1	4-201	CC1-08	CC1-36	CC1-01	-201		
						CC1-T2	NAT-PSN-6	CC1-T2	CC1-T2
TRACE(7)	119CC1-BT03	CALVERT CLIFFS 1	4-201	CC1-02	CC1-45	CC1-01	-201		
						CC1-T5	CC1-11	CC1-T5	CC1-T5
						CC1-T5	CC1-12	CC1-T5	CC1-T5
						CC1-T5	CC1-15	CC1-T5	CC1-T5
						CC1-T5	CC1-16	CC1-T5	CC1-T5
						CC1-T5	CC1-29	CC1-T5	CC1-T5
						CC1-T5	CC1-30	CC1-T5	CC1-T5
						CC1-T5	CC1-31	CC1-T5	CC1-T5
						CC1-T5	CC1-32	CC1-T5	CC1-T5
TRACE(8)	120CC1-BT03	CALVERT CLIFFS 1	4-201	CC1-03	CC1-48	CC1-01	-201		
						CC1-T5	CC1-81	CC1-T5	CC1-T5
						CC1-T5	CC1-82	CC1-T5	CC1-T5
						CC1-T5	CC1-84	CC1-T5	CC1-T5
						CC1-T5	CC1-85	CC1-T5	CC1-T5
						CC1-T5	CC1-86	CC1-T5	CC1-T5
						CC1-T5	CC1-87	CC1-T5	CC1-T5
						CC1-T5	CC1-88	CC1-T5	CC1-T5
						CC1-T5	CC1-89	CC1-T5	CC1-T5
TRACE(9)	121CC1-BT03	CALVERT CLIFFS 1	4-201	CC1-09	CC1-54	CC1-01	-201		
						CC1-T1	CC1-505	CC1-T1	CC1-T1
						CC1-T1	CC1-506	CC1-T1	CC1-T1
						CC1-T1	CC1-508	CC1-T1	CC1-T1
						CC1-T1	CC1-510	CC1-T1	CC1-T1
						CC1-T1	CC1-556	CC1-T1	CC1-T1
						CC1-T1	CC1-557	CC1-T1	CC1-T1
						CC1-T1	CC1-558	CC1-T1	CC1-T1
						CC1-T1	CC1-559	CC1-T1	CC1-T1
TRACE(10)	122CC1-BT03	CALVERT CLIFFS 1	3-201	CC1-10	CC1-60	CC1-01	-201		
						CC1-T3	CC1-672	CC1-T3	CC1-T3
						CC1-T3	CC1-673	CC1-T3	CC1-T3
						CC1-T3	CC1-674	CC1-T3	CC1-T3
						CC1-T3	CC1-675	CC1-T3	CC1-T3
						CC1-T3	CC1-727	CC1-T3	CC1-T3
						CC1-T3	CC1-728	CC1-T3	CC1-T3
						CC1-T3	CC1-729	CC1-T3	CC1-T3
						CC1-T3	CC1-730	CC1-T3	CC1-T3
TRACE(11)	31CC1-BT01	CALVERT CLIFFS 1	1-201	CC1-01	CC1-01	CC1-01	-201		
						CC1-NP	-101	CC1-NP	CC1-NP
TRACE(12)	32CC1-BT01	CALVERT CLIFFS 1	1-201	CC1-02	CC1-43	CC1-01	-201		
						CC1-T4	CC1-18	CC1-T5	CC1-T5
						CC1-T4	CC1-1	CC1-T5	CC1-T5
						CC1-T4	CC1-4	CC1-T5	CC1-T5
						CC1-T4	CC1-3	CC1-T5	CC1-T5
						CC1-T4	CC1-22	CC1-T5	CC1-T5

						CC1-T4	CC1-2	CC1-T5	CC1-T5
						CC1-T4	CC1-19	CC1-T5	CC1-T5
TRACE(13)	33CC1-BT01	CALVERT CLIFFS 1	1-201	CC1-03	CC1-46	CC1-01	-201		
						CC1-T4	CC1-61	CC1-T5	CC1-T5
						CC1-T4	CC1-35	CC1-T5	CC1-T5
						CC1-T4	CC1-69	CC1-T5	CC1-T5
						CC1-T4	CC1-67	CC1-T5	CC1-T5
						CC1-T4	CC1-65	CC1-T5	CC1-T5
						CC1-T4	CC1-64	CC1-T5	CC1-T5
						CC1-T4	CC1-63	CC1-T5	CC1-T5
						CC1-T4	CC1-62	CC1-T5	CC1-T5
TRACE(14)	34CC1-BT01	CALVERT CLIFFS 1	1-201	CC1-09	CC1-50	CC1-01	-201		
						CC1-T1	CC1-544	CC1-T1	CC1-T1
						CC1-T1	CC1-543	CC1-T1	CC1-T1
						CC1-T1	CC1-595	CC1-T1	CC1-T1
						CC1-T1	CC1-594	CC1-T1	CC1-T1
						CC1-T1	CC1-593	CC1-T1	CC1-T1
						CC1-T1	CC1-590	CC1-T1	CC1-T1
						CC1-T1	CC1-546	CC1-T1	CC1-T1
						CC1-T1	CC1-545	CC1-T1	CC1-T1
TRACE(15)	35CC1-BT02	CALVERT CLIFFS 1	2-201	CC1-01	CC1-05	CC1-01	-201		
						CC1-NP	-101	CC1-NP	CC1-NP
TRACE(16)	36CC1-BT02	CALVERT CLIFFS 1	2-201	CC1-01	CC1-06	CC1-01	-201		
						CC1-NP	-101	CC1-NP	CC1-NP
TRACE(17)	37CC1-BT02	CALVERT CLIFFS 1	3-201	CC1-07	CC1-20	CC1-01	-201		
						CC1-T2	-101	CC1-T2	CC1-T2
						CC1-T2	-101	CC1-T2	CC1-T2
TRACE(18)	38CC1-BT02	CALVERT CLIFFS 1	2-201	CC1-08	CC1-32	CC1-01	-201		
						CC1-T2	-101	CC1-T2	CC1-T2
TRACE(19)	39CC1-BT02	CALVERT CLIFFS 1	3-201	CC1-04	CC1-38	CC1-01	-201		
						CC1-T4	CC1-209	CC1-T4	CC1-T4
						CC1-T4	CC1-208	CC1-T4	CC1-T4
						CC1-T4	CC1-213	CC1-T4	CC1-T4
						CC1-T4	CC1-212	CC1-T4	CC1-T4
						CC1-T4	CC1-211	CC1-T4	CC1-T4
						CC1-T4	CC1-210	CC1-T4	CC1-T4
						CC1-T4	CC1-234	CC1-T4	CC1-T4
						CC1-T4	CC1-232	CC1-T4	CC1-T4
						CC1-T4	CC1-209	CC1-T4	CC1-T4
						CC1-T4	CC1-208	CC1-T4	CC1-T4
						CC1-T4	CC1-213	CC1-T4	CC1-T4
						CC1-T4	CC1-212	CC1-T4	CC1-T4
						CC1-T4	CC1-211	CC1-T4	CC1-T4
						CC1-T4	CC1-210	CC1-T4	CC1-T4
						CC1-T4	CC1-234	CC1-T4	CC1-T4
						CC1-T4	CC1-232	CC1-T4	CC1-T4
TRACE(20)	40CC1-BT02	CALVERT CLIFFS 1	3-201	CC1-05	CC1-41	CC1-01	-201		
						CC1-T4	CC1-158	CC1-T4	CC1-T4
						CC1-T4	CC1-157	CC1-T4	CC1-T4
						CC1-T4	CC1-174	CC1-T4	CC1-T4
						CC1-T4	CC1-173	CC1-T4	CC1-T4
						CC1-T4	CC1-164	CC1-T4	CC1-T4
						CC1-T4	CC1-161	CC1-T4	CC1-T4
						CC1-T4	CC1-191	CC1-T4	CC1-T4
						CC1-T4	CC1-175	CC1-T4	CC1-T4
						CC1-T4	CC1-158	CC1-T4	CC1-T4
						CC1-T4	CC1-157	CC1-T4	CC1-T4
						[illegible]	[illegible]	[illegible]	[illegible]

						CC1-T4	CC1-173	CC1-T4	CC1-T4
						CC1-T4	CC1-164	CC1-T4	CC1-T4
						CC1-T4	CC1-161	CC1-T4	CC1-T4
						CC1-T4	CC1-191	CC1-T4	CC1-T4
						CC1-T4	CC1-175	CC1-T4	CC1-T4
TRACE(21)	41CC1-BT02	CALVERT CLIFFS 1	2-201	CC1-03	CC1-47	CC1-01	-201		
						CC1-T5	CC1-71	CC1-T5	CC1-T5
						CC1-T5	CC1-70	CC1-T5	CC1-T5
						CC1-T5	CC1-77	CC1-T5	CC1-T5
						CC1-T5	CC1-76	CC1-T5	CC1-T5
						CC1-T5	CC1-74	CC1-T5	CC1-T5
						CC1-T5	CC1-73	CC1-T5	CC1-T5
						CC1-T5	CC1-79	CC1-T5	CC1-T5
						CC1-T5	CC1-78	CC1-T5	CC1-T5
TRACE(22)	42CC1-BT02	CALVERT CLIFFS 1	2-201	CC1-09	CC1-51	CC1-01	-201		
						CC1-T1	CC1-521	CC1-T1	CC1-T1
						CC1-T1	CC1-541	CC1-T1	CC1-T1
						CC1-T1	CC1-522	CC1-T1	CC1-T1
						CC1-T1	CC1-588	CC1-T1	CC1-T1
						CC1-T1	CC1-587	CC1-T1	CC1-T1
						CC1-T1	CC1-586	CC1-T1	CC1-T1
						CC1-T1	CC1-542	CC1-T1	CC1-T1
						CC1-T1	CC1-589	CC1-T1	CC1-T1
TRACE(23)	43CC1-BT02	CALVERT CLIFFS 1	3-201	CC1-09	CC1-52	CC1-01	-201		
						CC1-T1	CC1-515	CC1-T1	CC1-T1
						CC1-T1	CC1-517	CC1-T1	CC1-T1
						CC1-T1	CC1-516	CC1-T1	CC1-T1
						CC1-T1	CC1-584	CC1-T1	CC1-T1
						CC1-T1	CC1-583	CC1-T1	CC1-T1
						CC1-T1	CC1-582	CC1-T1	CC1-T1
						CC1-T1	CC1-518	CC1-T1	CC1-T1
						CC1-T1	CC1-585	CC1-T1	CC1-T1
						CC1-T1	CC1-515	CC1-T1	CC1-T1
						CC1-T1	CC1-517	CC1-T1	CC1-T1
						CC1-T1	CC1-516	CC1-T1	CC1-T1
						CC1-T1	CC1-584	CC1-T1	CC1-T1
						CC1-T1	CC1-583	CC1-T1	CC1-T1
						CC1-T1	CC1-582	CC1-T1	CC1-T1
						CC1-T1	CC1-518	CC1-T1	CC1-T1
						CC1-T1	CC1-585	CC1-T1	CC1-T1
TRACE(24)	44CC1-BT02	CALVERT CLIFFS 1	2-201	CC1-10	CC1-58	CC1-01	-201		
						CC1-T3	CC1-663	CC1-T3	CC1-T3
						CC1-T3	CC1-665	CC1-T3	CC1-T3
						CC1-T3	CC1-664	CC1-T3	CC1-T3
						CC1-T3	CC1-720	CC1-T3	CC1-T3
						CC1-T3	CC1-719	CC1-T3	CC1-T3
						CC1-T3	CC1-718	CC1-T3	CC1-T3
						CC1-T3	CC1-667	CC1-T3	CC1-T3
						CC1-T3	CC1-721	CC1-T3	CC1-T3
TRACE(25)	123DD0191	DRESDEN 3	3-201	DRESDEN3	KJ-0723	DRESDEN3	-101		
						NAT-PLN-B	-201	DRESDEN3-2	DRESDEN3-2
TRACE(26)	45DD0021	DRESDEN 3	3-201	DRESDEN3	KP-0451	DRESDEN3	-101		
						NAT-PLN-B	-201	DRESDEN3-1	DRESDEN3-1
TRACE(27)	46DD0710	DRESDEN 3	3-201	DRESDEN3	KB-5239	DRESDEN3	-101		
						NAT-PLN-B	-201	DRESDEN3-2	DRESDEN3-2
TRACE(28)	47DD0710	DRESDEN 3	3-201	DRESDEN3	KB-5249	DRESDEN3	-101		
						NAT-PLN-B	-201	DRESDEN3-2	DRESDEN3-2

TRACE(29)	481047	MAINE YANKEE	11022-2-3	MY-1	HBU-169	MY-1	-101		
						A	-101	MY-1	MY-1
TRACE(30)	491047	MAINE YANKEE	11022-2-1	MY-1	HBU-198	MY-1	-101		
						A	-101	MY-1	MY-1
TRACE(31)	501047	MAINE YANKEE	11022-3-3	MY-1	HBV-002	MY-1	-101		
						A	-101	MY-1	MY-1
TRACE(32)	511047	MAINE YANKEE	11022-4-2	MY-1	HBV-007	MY-1	-101		
						A	-101	MY-1	MY-1
TRACE(33)	521047	MAINE YANKEE	11022-1-3	MY-1	HBV-067	MY-1	-101		
						A	-101	MY-1	MY-1
TRACE(34)	532042	MAINE YANKEE	12018-2-3	MY-1	JBP-003	MY-1	-101		
						B	-101	MY-1	MY-1
TRACE(35)	542042	MAINE YANKEE	12018-1-2	MY-1	JBP-004	MY-1	-101		
						B	-101	MY-1	MY-1
TRACE(36)	552042	MAINE YANKEE	12018-2-3	MY-1	JBP-005	MY-1	-101		
						B	-101	MY-1	MY-1
TRACE(37)	562042	MAINE YANKEE	12018-4-2	MY-1	JBP-027	MY-1	-101		
						B	-101	MY-1	MY-1
TRACE(38)	572042	MAINE YANKEE	12018-2-3	MY-1	JBP-122	MY-1	-101		
						B	-101	MY-1	MY-1
TRACE(39)	582815	OCONEE 2	2-201	OCONEE-2	500C2	34417-OC2	-101		
						2007-20-04	-101	2007-20-04	-101
TRACE(40)	592815	OCONEE 2	2-201	OCONEE-2	510C2	34417-OC2	-101		
						2007-20-04	-101	2007-20-04	-101
TRACE(41)	602815	OCONEE 2	2-201	OCONEE-2	75003E	VDM1-OC2	-101		
						OC2-1	-101	OC2-1	OC2-1
TRACE(42)	612815	OCONEE 2	2-201	OCONEE-2	75004E	34429-OC2	-101		
						2007-20-04	-101	2007-20-04	OC2-C
TRACE(43)	622815	OCONEE 2	2-201	OCONEE-2	75007E	34429-OC2	-101		
						OC2-1	-101	OC2-1	OC2-1
TRACE(44)	632815	OCONEE 2	2-201	OCONEE-2	75010E	VDM2-OC2	-101		
						2007-20-04	-101	2007-20-04	OC2-C
TRACE(45)	642815	OCONEE 2	2-201	OCONEE-2	75011E	VDM2-OC2	-101		
						OC2-1	-101	OC2-1	OC2-1
TRACE(46)	652815	OCONEE 2	2-201	OCONEE-2	75012E	VDM1-OC2	-101		
						2007-20-14	-101	2007-20-14	OC2-C
TRACE(47)	662815	OCONEE 2	2-201	OCONEE-2	75015E	VDM2-OC2	-101		
						OC2-1	-101	OC2-1	OC2-1
TRACE(48)	672815	OCONEE 2	2-201	OCONEE-2	75018E	34429-OC2	-101		
						2007-20-14	-101	2007-20-14	OC2-C
TRACE(49)	682815	OCONEE 2	2-201	OCONEE-2	75019E	34417-OC2	-101		
						OC2-1	-101	OC2-1	OC2-1
						OC2-1	-101	OC2-1	OC2-1
TRACE(50)	692815	OCONEE 2	2-201	OCONEE-2	75023E	VDM1-OC2	-101		

TRACE(51)	702B15	OCONEE 2	2-201	OCONEE-2	75024E	VDM1-OC2 2007-20-14	-101 -101	2007-20-14	OC2-C
TRACE(52)	712B40	OCONEE 2	2-201	OCONEE-2	13897E	34417-OC2 2007-20-04	-101 -101	2007-20-04	OC2-C
TRACE(53)	722B40	OCONEE 2	2-201	OCONEE-2	13960E	34417-OC2 2007-20-04	-101 -101	2007-20-04	OC2-C
TRACE(54)	732B40	OCONEE 2	2-201	OCONEE-2	570C2	34417-OC2 2007-20-04	-101 -101	2007-20-04	-101
TRACE(55)	742B40	OCONEE 2	2-201	OCONEE-2	75025E	VDM1-OC2 OC2-1	-101 -101	OC2-1	OC2-1
TRACE(56)	752B40	OCONEE 2	2-201	OCONEE-2	75026E	VDM1-OC2 2007-20-04	-101 -101	2007-20-04	OC2-C
TRACE(57)	762B40	OCONEE 2	2-201	OCONEE-2	75028E	VDM2-OC2 2007-20-04	-101 -101	2007-20-04	OC2-C
TRACE(58)	772B40	OCONEE 2	2-201	OCONEE-2	75029E	34429-OC2 OC2-1	-101 -101	OC2-1	OC2-1
TRACE(59)	782B40	OCONEE 2	2-201	OCONEE-2	75030E	34429-OC2 2007-20-14	-101 -101	2007-20-14	OC2-C
TRACE(60)	792B40	OCONEE 2	2-201	OCONEE-2	75032E	34429-OC2 2007-20-14	-101 -101	2007-20-14	OC2-C
TRACE(61)	802B40	OCONEE 2	2-201	OCONEE-2	75033E	34429-OC2 OC2-1	-101 -101	OC2-1	OC2-1
TRACE(62)	812B40	OCONEE 2	2-201	OCONEE-2	75037E	VDM2-OC2 OC2-1	-101 -101	OC2-1	OC2-1
TRACE(63)	822B40	OCONEE 2	2-201	OCONEE-2	75038E	VDM1-OC2 2007-20-04	-101 -101	2007-20-04	OC2-C
TRACE(64)	832B40	OCONEE 2	2-201	OCONEE-2	75040E	VDM2-OC2 2007-20-04	-101 -101	2007-20-04	OC2-C
TRACE(65)	842B40	OCONEE 2	2-201	OCONEE-2	75041E	34417-OC2 OC2-1	-101 -101	OC2-1	OC2-1
TRACE(66)	852B40	OCONEE 2	2-201	OCONEE-2	75045E	34417-OC2 OC2-1	-101 -101	OC2-1	OC2-1
TRACE(67)	862B40	OCONEE 2	2-201	OCONEE-2	75046E	VDM2-OC2 2007-20-14	-101 -101	2007-20-14	OC2-C
TRACE(68)	870C4070	OYSTER CREEK	30C4070-1	7-1-OYC	YR2-00062	2701-OYC 58-2-OYC	NAI-TS-2 -201	58-2-OYC	7-1-OYC
TRACE(69)	880C4070	OYSTER CREEK	30C4070-1	7-2-OYC	YR3-00722	2704-OYC 59-5-OYC	NAI-TS-2 -201	59-5-OYC	7-2-OYC
TRACE(70)	890C4070	OYSTER CREEK	30C4070-2	7-2-OYC	YR3-00768	2802-OYC 59-1-6-OYC	NAI-TS-2 -201	59-1-6-OYC	7-2-OYC
TRACE(71)	900C4070	OYSTER CREEK	30C4070-2	7-3-OYC	YR4-00341	2705-OYC 60-3-5-OYC	NAI-TS-2 -201	60-3-5-OYC	7-3-OYC
TRACE(72)	910C4070	OYSTER CREEK	30C4070-2	7-3-OYC	YR4-00350	2705-OYC 60-3-5-OYC	NAI-TS-2 -201	60-3-5-OYC	7-3-OYC

TRACE(73)	920C4070	OYSTER CREEK	30C4070-4	7-3-OYC	Y84-00359	2705-OYC	NAI-TS-2		
						60-3-5-OYC	-201	60-3-5-OYC	7-3-OYC
TRACE(74)	930C4070	OYSTER CREEK	30C4070-3	7-4-OYC	Y01-00153	2690-OYC	NAI-TS-2		
						60-1-OYC	-201	60-1-OYC	7-4-OYC
TRACE(75)	1100C6054	OYSTER CREEK	10C6054-9	-201	OG2-00529	3775-OYC	S03-OYC		
						101-1-OYC	NAI-PSN-4	101-1-OYC	7-1-OYC
TRACE(76)	940C6059	OYSTER CREEK	10C6059-3	NAI-FRLN-3	OG2-00537	5484-OYC	W15-OYC		
						101-1-2-OYC	-201	101-1-2-OYC	7-1-OYC
TRACE(77)	950C6059	OYSTER CREEK	10C6059-9	NAI-FRLN-3	OG2-00541	5484-OYC	W20-OYC		
						101-1-OYC	-201	101-1-OYC	7-1-OYC
TRACE(78)	1110C6054	OYSTER CREEK	10C6054-5	NAI-FRLN-3	OG3-01081	3775-OYC	S08-OYC		
						102-5-OYC	NAI-PSN-4	102-5-OYC	7-2-OYC
TRACE(79)	960C6059	OYSTER CREEK	10C6059-10	NAI-FRLN-3	OG3-01103	5484-OYC	W16-OYC		
						102-5-OYC	-201	102-5-OYC	7-2-OYC
TRACE(80)	1120C6054	OYSTER CREEK	10C6054-6	NAI-FRLN-3	OG4-03684	3775-OYC	S25-OYC		
						103-2-OYC	NAI-PSN-3	103-2-OYC	7-3-OYC
TRACE(81)	970C6059	OYSTER CREEK	10C6059-6	NAI-FRLN-3	OG4-03694	5484-OYC	W49-OYC		
						103-2-OYC	-201	103-2-OYC	7-3-OYC
TRACE(82)	980C6059	OYSTER CREEK	10C6059-10	NAI-FRLN-3	OG4-03697	5484-OYC	W63-OYC		
						103-2-OYC	-201	103-2-OYC	7-3-OYC
TRACE(83)	1090C6054	OYSTER CREEK	10C6054-3	NAI-FRLN-3	OG2-00521	3775-OYC	S10-OYC		
						101-1-OYC	NAI-PSN-3	101-1-OYC	7-1-OYC
TRACE(84)	1UD000A	OYSTER CREEK	5NAI-FRGN-4	NAI-FRLN-1	CB20001	THN7-OYC	NAI-TS-1		
						NAI-PLN-1	NAI-PSN-1	NAI-PTN-1	-101
TRACE(85)	2UD000A	OYSTER CREEK	5NAI-FRGN-4	NAI-FRLN-1	CB20002	THN7-OYC	NAI-TS-1		
						NAI-PLN-1	NAI-PSN-1	NAI-PTN-1	-101
TRACE(86)	3UD000A	OYSTER CREEK	5NAI-FRGN-3	NAI-FRLN-1	CB40002	THN7-OYC	NAI-TS-1		
						NAI-PLN-2	NAI-PSN-1	NAI-PTN-1	-101
TRACE(87)	4UD000A	OYSTER CREEK	5NAI-FRGN-3	NAI-FRLN-1	CB40004	THN7-OYC	NAI-TS-1		
						NAI-PLN-2	NAI-PSN-1	NAI-PTN-1	-101
TRACE(88)	5UD000A	OYSTER CREEK	5NAI-FRGN-3	NAI-FRLN-1	CB40005	THN7-OYC	NAI-TS-1		
						NAI-PLN-2	NAI-PSN-1	NAI-PTN-1	-101
TRACE(89)	6UD000A	OYSTER CREEK	5NAI-FRGN-1	NAI-FRLN-1	CB40007	THN7-OYC	NAI-TS-1		
						NAI-PLN-2	NAI-PSN-1	NAI-PTN-1	-101
TRACE(90)	7UD000A	OYSTER CREEK	5NAI-FRGN-3	NAI-FRLN-1	CB40009	THN7-OYC	NAI-TS-1		
						NAI-PLN-2	NAI-PSN-1	NAI-PTN-1	-101
TRACE(91)	8UD000A	OYSTER CREEK	5NAI-FRGN-2	NAI-FRLN-1	CB40011	THN7-OYC	NAI-TS-1		
						NAI-PLN-2	NAI-PSN-1	NAI-PTN-1	-101
TRACE(92)	9UD000A	OYSTER CREEK	5NAI-FRGN-3	NAI-FRLN-1	CB40015	THN7-OYC	NAI-TS-1		
						NAI-PLN-2	NAI-PSN-1	NAI-PTN-1	-101
TRACE(93)	10UD000A	OYSTER CREEK	5NAI-FRGN-3	NAI-FRLN-1	CB40016	THN7-OYC	NAI-TS-1		
						NAI-PLN-2	NAI-PSN-1	NAI-PTN-1	-101
TRACE(94)	11UD000A	OYSTER CREEK	5NAI-FRGN-3	NAI-FRLN-1	CB40017	THN7-OYC	NAI-TS-1		

TRACE(95)	12UD000A	OYSTER CREEK	5NAI-FRGN-4	NAI-FRLN-1	CB40018	THN7-OYC NAI-PLN-2	NAI-TS-1 NAI-PSN-1	NAI-PTN-1	-101
TRACE(96)	13UD000A	OYSTER CREEK	5NAI-FRGN-3	NAI-FRLN-1	CB40019	THN7-OYC NAI-PLN-2	NAI-TS-1 NAI-PSN-1	NAI-PTN-1	-101
TRACE(97)	14UD000A	OYSTER CREEK	5NAI-FRGN-3	NAI-FRLN-1	CB40020	THN7-OYC NAI-PLN-2	NAI-TS-1 NAI-PSN-1	NAI-PTN-1	-101
TRACE(98)	15UD000A	OYSTER CREEK	5NAI-FRGN-3	NAI-FRLN-1	CB40021	THN7-OYC NAI-PLN-2	NAI-TS-1 NAI-PSN-1	NAI-PTN-1	-101
TRACE(99)	16UD000A	OYSTER CREEK	5NAI-FRGN-2	NAI-FRLN-1	CC20001	THK7-OYC NAI-PLN-1	NAI-TS-1 NAI-PSN-2	NAI-PTN-1	-101
TRACE(100)	17UD000A	OYSTER CREEK	5NAI-FRGN-3	NAI-FRLN-1	CC20002	THK7-OYC NAI-PLN-1	NAI-TS-1 NAI-PSN-2	NAI-PTN-1	-101
TRACE(101)	18UD000A	OYSTER CREEK	5NAI-FRGN-2	NAI-FRLN-1	CC20003	THK7-OYC NAI-PLN-1	NAI-TS-1 NAI-PSN-2	NAI-PTN-1	-101
TRACE(102)	19UD000A	OYSTER CREEK	5NAI-FRGN-3	NAI-FRLN-1	CC30001	THN7-OYC NAI-PLN-3	NAI-TS-1 NAI-PSN-1	NAI-PTN-1	-101
TRACE(103)	20UD000A	OYSTER CREEK	5NAI-FRGN-2	NAI-FRLN-1	CC30002	THK7-OYC NAI-PLN-3	NAI-TS-1 NAI-PSN-2	NAI-PTN-1	-101
TRACE(104)	21UD000A	OYSTER CREEK	5NAI-FRGN-3	NAI-FRLN-1	CC30003	THK7-OYC NAI-PLN-3	NAI-TS-1 NAI-PSN-2	NAI-PTN-1	-101
TRACE(105)	22UD000A	OYSTER CREEK	5NAI-FRGN-4	NAI-FRLN-1	CC30009	THK7-OYC NAI-PLN-3	NAI-TS-1 NAI-PSN-2	NAI-PTN-1	-101
TRACE(106)	23UD000A	OYSTER CREEK	5NAI-FRGN-3	NAI-FRLN-1	CC30016	THK7-OYC NAI-PLN-3	NAI-TS-1 NAI-PSN-2	NAI-PTN-1	-101
TRACE(107)	24UD000A	OYSTER CREEK	5NAI-FRGN-3	NAI-FRLN-1	CC30023	THK7-OYC NAI-PLN-3	NAI-TS-1 NAI-PSN-2	NAI-PTN-1	-101
TRACE(108)	25UD000A	OYSTER CREEK	5NAI-FRGN-4	NAI-FRLN-1	CC40001	THK7-OYC NAI-PLN-1	NAI-TS-1 NAI-PSN-2	NAI-PTN-1	-101
TRACE(109)	26UD000A	OYSTER CREEK	5NAI-FRGN-3	NAI-FRLN-1	CC40002	THK7-OYC NAI-PLN-1	NAI-TS-1 NAI-PSN-2	NAI-PTN-1	-101
TRACE(110)	27UD000A	OYSTER CREEK	5NAI-FRGN-4	NAI-FRLN-1	CC40003	THK7-OYC NAI-PLN-1	NAI-TS-1 NAI-PSN-2	NAI-PTN-1	-101
TRACE(111)	28UD000A	OYSTER CREEK	5NAI-FRGN-4	NAI-FRLN-1	CC40004	THK7-OYC NAI-PLN-1	NAI-TS-1 NAI-PSN-2	NAI-PTN-1	-101
TRACE(112)	29UD000A	OYSTER CREEK	5NAI-FRGN-3	NAI-FRLN-1	CF10001	THN7-OYC NAI-PLN-1	NAI-TS-1 NAI-PSN-1	NAI-PTN-1	-101
TRACE(113)	30UD000A	OYSTER CREEK	5NAI-FRGN-1	NAI-FRLN-1	CF10002	THN7-OYC NAI-PLN-1	NAI-TS-1 NAI-PSN-1	NAI-PTN-1	-101
TRACE(114)	99LJLTA2	PEACH BOTTOM 2	2PB2-10	1-PB2	DJD0245	NAI-TLN-1 NAI-PLN-7	-101 -201	PB2-1	PB2-1
TRACE(115)	100LJLTA2	PEACH BOTTOM 2	2PB2-10	1-PB2	DJD0277	NAI-TLN-1 NAI-PLN-7	-101 -201	PB2-1	PB2-1
TRACE(116)	101D-14	POINT BEACH 1	2-201	PB1	AI-PB1	SAW [illegible]	-101 [illegible]	[illegible]	[illegible]

TRACE(117)	1020-14	POINT BEACH 1	2-201	PB1	A9-PB1	5BA	-101		
						16-PB1	-201	16-PB1	PB1
TRACE(118)	1030-14	POINT BEACH 1	2-201	PB1	B11-PB1	5BG	-101		
						22-PB1	-201	22-PB1	PB1
TRACE(119)	1040-14	POINT BEACH 1	2-201	PB1	E3-PB1	5AY	-101		
						30-PB1	-201	30-PB1	PB1
TRACE(120)	1050-14	POINT BEACH 1	2-201	PB1	K6-PB1	5AW	-101		
						11-PB1	-201	11-PB1	PB1
TRACE(121)	106C64-Z1	ZION 1	3C64-Z1-2	569	601-71	N546	-101		
						-101	NAI-PSN-7	2906	325-14-2
						-101	NAI-PSN-7	2385	318-07-2
						-101	NAI-PSN-7	2984	325-69-2
						-101	NAI-PSN-7	2975	325-66-2
						-101	NAI-PSN-7	2943	325-43-2
						-101	NAI-PSN-7	2942	325-46-1
						-101	NAI-PSN-7	2938	325-41-2
TRACE(122)	107C64-Z1	ZION 1	3C64-Z1-1	570	614-71	N546	-101		
						-101	NAI-PSN-7	2955	325-54-2
						-101	NAI-PSN-7	2973	325-65-2
						-101	NAI-PSN-7	2966	325-59-1
						-101	NAI-PSN-7	3817	325-94-2
						-101	NAI-PSN-7	2977	325-66-2
						-101	NAI-PSN-7	2976	325-56-1
						-101	NAI-PSN-7	2974	325-66-1
TRACE(123)	108C64-Z1	ZION 1	3C64-Z1-1	570	680-71	N592	-101		
						-101	NAI-PSN-7	2974	325-66-1
						-101	NAI-PSN-7	2973	325-65-2
						-101	NAI-PSN-7	2966	325-59-1
						-101	NAI-PSN-7	2055	325-54-2
						-101	NAI-PSN-7	3817	325-94-2
						-101	NAI-PSN-7	2977	325-66-2
						-101	NAI-PSN-7	2976	325-56-1

PHASE 2 TRACE PARAMETERS

(Rods 124-293)

NROD / RJ	DRC	AN	RN	NOCI	FRGN	FRLN	FRS	TLN / PLN	TS / PSN	PTN	SBN
TRACE(1)	124	0C6054	OYSTER CREEK		10C6054-1	NAI-FRLN-3	0G2-00523	3775-0YC 101-1-2-0YC	S11-0YC -201	101-1-2-0YC	7-1-0YC
TRACE(2)	125	0C6054	OYSTER CREEK		10C6054-9	NAI-FRLN-3	0G2-00530	3775-0YC 101-1-0YC	S05-0YC -201	101-1-0YC	7-1-0YC
TRACE(3)	126	0C6059	OYSTER CREEK		10C6059-9	NAI-FRLN-3	0G2-00542	5484-0YC 101-2-0YC	W23-0YC -201	101-2-0YC	7-1-0YC

TRACE(4)	1270C6054	OYSTER CREEK	10C6054-10	NAI-FRLN-3	OG3-01085	3775-OYC 102-5-OYC	514-OYC -201	102-5-OYC	7-2-OYC
TRACE(5)	1280C6054	OYSTER CREEK	10C6054-7	NAI-FRLN-3	OG4-03682	3775-OYC 103-2-OYC	523-OYC -201	102-3-OYC	7-3-OYC
TRACE(6)	1290C6059	OYSTER CREEK	10C6059-6	NAI-FRLN-3	OG4-03696	5484-OYC 103-2-OYC	W54-OYC -201	103-2-OYC	7-3-OYC
TRACE(7)	1300C6059	OYSTER CREEK	10C6059-1	NAI-FRLN-3	OG2-00538	5484-OYC 101-1-2-OYC	W22-OYC -201	101-1-2-OYC	7-1-OYC
TRACE(8)	1310C6059	OYSTER CREEK	10C6059-5	NAI-FRLN-3	OG3-01102	5484-OYC 102-5-OYC	W12-OYC -201	102-5-OYC	7-2-OYC
TRACE(9)	1320C6059	OYSTER CREEK	10C6059-7	NAI-FRLN-3	OG4-03695	5484-OYC 103-2-OYC	W50-OYC -201	103-2-OYC	7-3-OYC
TRACE(10)	1330C4070	OYSTER CREEK	30C4070-2	NAI-FRLN-3	YB2-00043	2701-OYC 58-2-OYC	NAI-TS-2 -201	58-2-OYC	7-1-OYC
TRACE(11)	1340C4070	OYSTER CREEK	30C4070-1	NAI-FRLN-3	YB2-00044	2701-OYC 58-2-OYC	NAI-TS-2 -201	58-2-OYC	7-1-OYC
TRACE(12)	1350C4070	OYSTER CREEK	30C4070-1	NAI-FRLN-3	YB3-00218	2704-OYC 59-5-OYC	NAI-TS-2 -201	59-5-OYC	7-2-OYC
TRACE(13)	1360C4070	OYSTER CREEK	30C4070-4	NAI-FRLN-3	YB4-00337	2705-OYC 60-3-OYC	NAI-TS-2 -201	60-3-OYC	7-3-OYC
TRACE(14)	1370C4070	OYSTER CREEK	30C4070-2	NAI-FRLN-3	YB4-00347	2705-OYC 60-3-5-OYC	NAI-TS-2 -201	60-3-5-OYC	7-3-OYC
TRACE(15)	1380C4070	OYSTER CREEK	30C4070-2	NAI-FRLN-3	YB4-00348	2705-OYC 60-3-5-OYC	NAI-TS-2 -201	60-3-5-OYC	7-3-OYC
TRACE(16)	139000706	DRESDEN 3	3-201	DRESDEN3	KE-2225	DRESDEN3 -101	-101 -201	DRESDEN3-4	DRESDEN3-4
TRACE(17)	140000191	DRESDEN 3	3-201	DRESDEN3	KC-4411	DRESDEN3 -101	-101 -201	DRESDEN3-3	DRESDEN3-3
TRACE(18)	141000706	DRESDEN 3	3-201	DRESDEN3	KG-2119	DRESDEN3 -101	-101 -201	DRESDEN3-5	DRESDEN3-5
TRACE(19)	1422069	MAINE YANKEE	12061-2-2	MY-1	JCN-182	MY-1 B	-101 -101	MY-1	MY-1
TRACE(20)	1432069	MAINE YANKEE	12061-4-3	MY-1	JBY-157	MY-1 B	-101 -101	MY-1	MY-1
TRACE(21)	1442069	MAINE YANKEE	12061-2-2	MY-1	JBY-142	MY-1 B	-101 -101	MY-1	MY-1
TRACE(22)	1454231	MAINE YANKEE	14229-3-1	MY-1	KCA-125	MY-1 C	-101 -101	MY-1	MY-1
TRACE(23)	1462069	MAINE YANKEE	12061-3-3	MY-1	JCN-199	MY-1 B	-101 -101	MY-1	MY-1
TRACE(24)	1472069	MAINE YANKEE	12061-3-3	MY-1	JCN-196	MY-1 B	-101 -101	MY-1	MY-1
TRACE(25)	1482069	MAINE YANKEE	12061-4-3	MY-1	JBY-097	MY-1 B	-101 -101	MY-1	MY-1

TRACE([illegible])	[illegible]31	MAINE YANKEE	1-101	MY-1	[illegible]	MY-1 C	-101 -101	MY-1	MY-1
TRACE(27)	150423I	MAINE YANKEE	1-101	MY-1	KCA-109	MY-1 C	-101 -101	MY-1	MY-1
TRACE(28)	151423I	MAINE YANKEE	1-101	MY-1	KCA-185	MY-1 C	-101 -101	MY-1	MY-1
TRACE(29)	152LJLTA3	PEACH BOTTOM 2	2PB2-10	1-PB2	DJD0163	NAI-TLN-1 -201	-101 -201	PB2-1	PB2-1
TRACE(30)	153LJLTA3	PEACH BOTTOM 2	2PB2-15	1-PB2	DJD0191	NAI-TLN-1 -201	-101 -201	PB2-1	PB2-1
TRACE(31)	154LJLTA3	PEACH BOTTOM 2	2PB2-6	1-PB2	DJD0309	NAI-TLN-1 -201	-101.00 -201	PB2-1	PB2-1
TRACE(32)	155LJLTA3	PEACH BOTTOM 2	2PB2-6	1-PB2	DJD0306	NAI-TLN-1 -201	-101.00 -201	PB2-1	PB2-1
TRACE(33)	156G02-BRP	BIG ROCK POINT	-101-101	-101	JJ400002	-101 -101	-101 -101	-101	-101
TRACE(34)	157G02-BRP	BIG ROCK POINT	-101-101	-101	JK400001	-101 -101	-101 -101	-101	-101
TRACE(35)	158G01-BRP	BIG ROCK POINT	-101-101	-101	JM400008	-101 -101	-101 -101	-101	-101
TRACE(36)	159D71-BRP	BIG ROCK POINT	-101-101	-101	AB400003	-101 -101	-101 -101	-101	-101
TRACE(37)	160D71-BRP	BIG ROCK POINT	-101-101	-101	AB300001	-101 -101	-101 -101	-101	-101
TRACE(38)	161D71-BRP	BIG ROCK POINT	-101-101	-101	AB200001	-101 -101	-101 -101	-101	-101
TRACE(39)	162D71-BRP	BIG ROCK POINT	-101-101	-101	AB100001	-101 -101	-101 -101	-101	-101
TRACE(40)	163D71-BRP	BIG ROCK POINT	-101-101	-101	AB400001	-101 -101	-101 -101	-101	-101
TRACE(41)	164G21-BRP	BIG ROCK POINT	-101-101	-101	PT300002	-101 -101	-101 -101	-101	-101
TRACE(42)	165G21-BRP	BIG ROCK POINT	-101-101	-101	PS300002	-101 -101	-101 -101	-101	-101
TRACE(43)	166D72-BRP	BIG ROCK POINT	-101-101	-101	XA30303	-101 -101	-101 -101	-101	-101
TRACE(44)	167G02-BRP	BIG ROCK POINT	-101-101	-101	XB30206	-101 -101	-101 -101	-101	-101
TRACE(45)	168G02-BRP	BIG ROCK POINT	-101-101	-101	XB30307	-101 -101	-101 -101	-101	-101
TRACE(46)	169CC1-BT03	CALVERT CLIFFS 1	3-201	CC1-04	CC1-39	CC1-01 CC1-T4 CC1-T4 CC1-T4 CC1-T4 CC1-T4	-201 CC1-236 CC1-237 CC1-238 CC1-239 CC1-240	CC1-T4 CC1-T4 CC1-T4 CC1-T4 CC1-T4	CC1-T4 CC1-T4 CC1-T4 CC1-T4 CC1-T4

					CC1-T4	CC1-243	CC1-T4	CC1-T4
					CC1-T4	CC1-244	CC1-T4	CC1-T4
TRACE(47) 170CC1-8T03	CALVERT CLIFFS 1	3-201	CC1-05	CC1-42	CC1-01	-201		
					CC1-T4	CC1-165	CC1-T4	CC1-T4
					CC1-T4	CC1-166	CC1-T4	CC1-T4
					CC1-T4	CC1-167	CC1-T4	CC1-T4
					CC1-T4	CC1-168	CC1-T4	CC1-T4
					CC1-T4	CC1-192	CC1-T4	CC1-T4
					CC1-T4	CC1-195	CC1-T4	CC1-T4
					CC1-T4	CC1-196	CC1-T4	CC1-T4
					CC1-T4	CC1-197	CC1-T4	CC1-T4
TRACE(48) 171CC1-8T03	CALVERT CLIFFS 1	3-201	CC1-09	CC1-53	CC1-01	-201		
					CC1-T1	CC1-511	CC1-T1	CC1-T1
					CC1-T1	CC1-512	CC1-T1	CC1-T1
					CC1-T1	CC1-513	CC1-T1	CC1-T1
					CC1-T1	CC1-514	CC1-T1	CC1-T1
					CC1-T1	CC1-560	CC1-T1	CC1-T1
					CC1-T1	CC1-561	CC1-T1	CC1-T1
					CC1-T1	CC1-562	CC1-T1	CC1-T1
					CC1-T1	CC1-581	CC1-T1	CC1-T1
TRACE(49) 172CC1-8T03	CALVERT CLIFFS 1	3-201	CC1-01	CC1-11	CC1-01	-201		
					CC1-NP	-101	CC1-NP	CC1-NP
TRACE(50) 173CC1-8T03	CALVERT CLIFFS 1	4-201	CC1-07	CC1-23	CC1-01	-201		
					CC1-T2	-101	CC1-T2	CC1-T2
TRACE(51) 174CC1-8T03	CALVERT CLIFFS 1	4-201	CC1-08	CC1-33	CC1-01	-201		
					CC1-T2	CC1-319	CC1-T2	CC1-T2
					CC1-T2	CC1-320	CC1-T2	CC1-T2
					CC1-T2	CC1-321	CC1-T2	CC1-T2
					CC1-T2	CC1-322	CC1-T2	CC1-T2
					CC1-T2	CC1-347	CC1-T2	CC1-T2
					CC1-T2	CC1-348	CC1-T2	CC1-T2
					CC1-T2	CC1-349	CC1-T2	CC1-T2
					CC1-T2	CC1-351	CC1-T2	CC1-T2
TRACE(52) 175CC1-8T03	CALVERT CLIFFS 1	4-201	CC1-01	CC1-09	CC1-01	-201		
					CC1-NP	-101	CC1-NP	CC1-NP
TRACE(53) 176CC1-8T02	CALVERT CLIFFS 1	2-201	CC1-07	CC1-19	CC1-01	-201		
					CC1-T2	-101	CC1-T2	CC1-T2
TRACE(54) 177CC1-8T03	CALVERT CLIFFS 1	4-201	CC1-07	CC1-25	CC1-01	-201		
					CC1-T2	-101	CC1-T2	CC1-T2
TRACE(55) 178CC1-8T01	CALVERT CLIFFS 1	1-201	CC1-01	CC1-03	CC1-01	-201		
					CC1-NP	-101	CC1-NP	CC1-NP
TRACE(56) 179CC1-8T02	CALVERT CLIFFS 1	3-201	CC1-08	CC1-31	CC1-01	-201		
					CC1-T2	-101	CC1-T2	CC1-T2
TRACE(57) 180CC1-8T03	CALVERT CLIFFS 1	4-201	CC1-08	CC1-35	CC1-01	-201		
					CC1-T2	-101	CC1-T2	CC1-T2
TRACE(58) 181CC1-8T01	CALVERT CLIFFS 1	1-201	CC1-04	CC1-37	CC1-01	-201		
					CC1-T4	CC1-198	CC1-T4	CC1-T4
					CC1-T4	CC1-199	CC1-T4	CC1-T4
					CC1-T4	CC1-200	CC1-T4	CC1-T4
					CC1-T4	CC1-201	CC1-T4	CC1-T4
					CC1-T4	CC1-202	CC1-T4	CC1-T4
					CC1-T4	CC1-204	CC1-T4	CC1-T4
					CC1-T4	CC1-205	CC1-T4	CC1-T4

						CC1-T4	CC1-207	CC1-T4	CC1-T5
TRACE(59)	182CC1-BT01	CALVERT CLIFFS 1	1-201	CC1-05	CC1-40	CC1-01	-201		
						CC1-T4	CC1-152	CC1-T4	CC1-T4
						CC1-T4	CC1-153	CC1-T4	CC1-T4
						CC1-T4	CC1-155	CC1-T4	CC1-T4
						CC1-T4	CC1-156	CC1-T4	CC1-T4
						CC1-T4	CC1-169	CC1-T4	CC1-T4
						CC1-T4	CC1-170	CC1-T4	CC1-T4
						CC1-T4	CC1-171	CC1-T4	CC1-T4
						CC1-T4	CC1-172	CC1-T4	CC1-T4
TRACE(60)	183CC1-BT02	CALVERT CLIFFS 1	3-201	CC1-02	CC1-44	CC1-01	-201		
						CC1-T5	CC1-10	CC1-T5	CC1-T5
						CC1-T5	CC1-23	CC1-T5	CC1-T5
						CC1-T5	CC1-24	CC1-T5	CC1-T5
						CC1-T5	CC1-26	CC1-T5	CC1-T5
						CC1-T5	CC1-27	CC1-T5	CC1-T5
						CC1-T5	CC1-5	CC1-T5	CC1-T5
						CC1-T5	CC1-6	CC1-T5	CC1-T5
						CC1-T5	CC1-7	CC1-T5	CC1-T5
TRACE(61)	184CC1-BT01	CALVERT CLIFFS 1	1-201	CC1-10	CC1-55	CC1-01	-201		
						CC1-T3	CC1-652	CC1-T3	CC1-T3
						CC1-T3	CC1-653	CC1-T3	CC1-T3
						CC1-T3	CC1-654	CC1-T3	CC1-T3
						CC1-T3	CC1-676	CC1-T3	CC1 T3
						CC1-T3	CC1-677	CC1-T3	CC1 T3
						CC1-T3	CC1-678	CC1-T3	CC1-T3
						CC1-T3	CC1-681	CC1-T3	CC1-T3
						CC1-T3	CC1-651	CC1-T3	CC1-T3
TRACE(62)	185CC1-BT03	CALVERT CLIFFS 1	4-201	CC1-10	CC1-59	CC1-01	-201		
						CC1-T3	CC1-668	CC1-T3	CC1-T3
						CC1-T3	CC1-669	CC1-T3	CC1-T3
						CC1-T3	CC1-670	CC1-T3	CC1-T3
						CC1-T3	CC1-671	CC1-T3	CC1-T3
						CC1-T3	CC1-722	CC1-T3	CC1-T3
						CC1-T3	CC1-723	CC1-T3	CC1-T3
						CC1-T3	CC1-725	CC1-T3	CC1-T3
						CC1-T3	CC1-726	CC1-T3	CC1-T3
TRACE(63)	1862840	OCONEE 2	2-201	OCONEE-2	75042E	34429-OC2	-101		
						2007-20-14	-101	2007-20-14	OC2-C
TRACE(64)	1872840	OCONEE 2	2-201	OCONEE-2	75036E	VDM1-OC2	-101		
						2007-20-04	-101	2007-20-04	OC2-C
TRACE(65)	1882840	OCONEE 2	2-201	OCONEE-2	75034E	VDM2-OC2	-101		
						2007-20-04	-101	2007-20-04	OC2-C
TRACE(66)	1892840	OCONEE 2	2-201	OCONEE-2	75043E	34417-OC2	-101		
						OC2-1	-101	OC2-1	OC2-L
TRACE(67)	1902840	OCONEE 2	2-201	OCONEE-2	75047E	VDM1-OC2	-101		
						OC2-1	-101	OC2-1	OC2-L
TRACE(68)	1912840	OCONEE 2	2-201	OCONEE-2	75039E	VDM2-OC2	-101		
						OC2-1	-101	OC2-1	OC2-L
TRACE(69)	1922840	OCONEE 2	2-201	OCONEE-2	13931E	34417-OC2	-101		
						2007-20-04	-101	2007-20-04	OC2-C
TRACE(70)	1932815	OCONEE 2	2-201	OCONEE-2	49OC2	34417-OC2	-101		
						2007-20-04	-101	2007-20-04	-101

TRACE(71)	1952840	OCONEE 2	2-201	OCONEE-2	54OC2	34417-OC2	-101		
						2007-20-04	-101	2007-20-04	-101
TRACE(72)	1952840	OCONEE 2	2-201	OCONEE-2	58OC2	34417-OC2	-101		
						2007-20-04	-101	2007-20-04	-101
TRACE(73)	1962815	OCONEE 2	2-201	OCONEE-2	75001E	VDM1-OC2	-101		
						OC2-1	-101	OC2-1	OC2-L
TRACE(74)	1972815	OCONEE 2	2-201	OCONEE-2	75002E	VDM1-OC2	-101		
						2007-20-14	-101	2007-20-14	OC2-C
TRACE(75)	1982815	OCONEE 2	2-201	OCONEE-2	75005E	34429-OC2	-101		
						OC2-1	-101	OC2-1	OC2-L
TRACE(76)	1992815	OCONEE 2	2-201	OCONEE-2	75008E	34429-OC2	-101		
						2007-20-14	-101	2007-20-14	OC2-C
TRACE(77)	2002815	OCONEE 2	2-201	OCONEE-2	75009E	34429-OC2	-101		
						OC2-1	-101	OC2-1	OC2-L
TRACE(78)	2012815	OCONEE 2	2-201	OCONEE-2	75013E	VDM2-OC2	-101		
						OC2-1	-101	OC2-1	OC2-L
TRACE(79)	2022815	OCONEE 2	2-201	OCONEE-2	75014E	VDM1-OC2	-101		
						2007-20-14	-101	2007-20-14	OC2-C
TRACE(80)	2032815	OCONEE 2	2-201	OCONEE-2	75016E	VDM2-OC2	-101		
						2007-20-14	-101	2007-20-14	OC2-C
TRACE(81)	2042815	OCONEE 2	2-201	OCONEE-2	75017E	34417-OC2	-101		
						OC2-1	-101	OC2-1	OC2-L
TRACE(82)	2052815	OCONEE 2	2-201	OCONEE-2	75020E	34429-OC2	-101		
						2007-20-04	-101	2007-20-04	OC2-C
TRACE(83)	2062815	OCONEE 2	2-201	OCONEE-2	75021E	34417-OC2	-101		
						OC2-1	-101	OC2-1	OC2-L
TRACE(84)	2072815	OCONEE 2	2-201	OCONEE-2	75022E	VDM2-OC2	-101		
						2007-20-14	-101	2007-20-14	OC2-C
TRACE(85)	2082840	OCONEE 2	2-201	OCONEE-2	75027E	VDM1-OC2	-101		
						OC2-1	-101	OC2-1	OC2-L
TRACE(86)	2092840	OCONEE 2	2-201	OCONEE-2	75031E	34429-OC2	-101		
						OC2-1	-101	OC2-1	OC2-L
TRACE(87)	2102840	OCONEE 2	2-201	OCONEE-2	75035E	VDM2-OC2	-101		
						OC2-1	-101	OC2-1	OC2-L
TRACE(88)	2112840	OCONEE 2	2-201	OCONEE-2	75044E	34429-OC2	-101		
						2007-20-14	-101	2007-20-14	OC2-C
TRACE(89)	2122840	OCONEE 2	2-201	OCONEE-2	75048E	VDM1-OC2	-101		
						2007-20-14	-101	2007-20-14	OC2-C
TRACE(90)	2132815	OCONEE 2	2-201	OCONEE-2	52OC2	34417-OC2	-101		
						2007-20-04	-101	2007-20-04	-101
TRACE(91)	2142815	OCONEE 2	2-201	OCONEE-2	75004E	VDM2-OC2	-101		
						2007-20-04	-101	2007-20-04	OC2-C
TRACE(92)	2150-40	POINT BEACH 1	2-201	PB1	045-PB1	5BG	-101		
						4B-PB1	-201	4B-PB1	PB1
						[illegible]	[illegible]	[illegible]	[illegible]

					[illegible]	[illegible]	[illegible]	[illegible]
					48-PB1	-201	531-PB1	PB1
					48-PB1	-201	541-PB1	PB1
					48-PB1	-201	545-PB1	PB1
					48-PB1	-201	553-PB1	PB1
TRACE(93) 216D-40	POINT BEACH 1	2-201	PB1	037-PB1	58G	-101		
					48-PB1	-201	47-PB1	PB1
TRACE(94) 217C63-Z1	ZION 1	3C63-Z1-2	571	622-Z1	N546	-101		
					-101	-101	2907	325-11-2
					-101	-101	2964	323-85-2
					-101	-101	2965	325-46-2
					-101	-101	2978	325-69-1
					-101	-101	2983	325-73-2
					-101	-101	3824	325-82-1
					-101	-101	3825	325-93-1
TRACE(95) 218C63-Z1	ZION 1	3C63-Z1-2	569	646-Z1	N592	-101		
					-101	-101	2385	318-07-2
					-101	-101	2906	325-14-2
					-101	-101	2938	325-41-2
					-101	-101	2942	325-46-1
					-101	-101	2943	325-43-2
					-101	-101	2975	325-66-2
					-101	-101	2984	325-69-2
TRACE(96) 219C63-Z1	ZION 1	3C63-Z1-1	570	654-Z1	N592	-101		
					-101	-101	2955	325-54-2
					-101	-101	2956	325-59-1
					-101	-101	2973	325-65-2
					-101	-101	2974	325-66-1
					-101	-101	2976	325-56-1
					-101	-101	2977	325-66-2
					-101	-101	3817	325-94-2
TRACE(97) 220C63-Z1	ZION 1	3C63-Z1-2	571	663-Z1	N592	-101		
					-101	-101	2907	325-11-2
					-101	-101	2964	323-85-2
					-101	-101	2965	325-46-2
					-101	-101	2978	325-69-1
					-101	-101	2983	325-73-2
					-101	-101	3824	325-82-1
					-101	-101	3825	325-93-1
TRACE(98) 221RD-2	SURRY 2	3-201	025-S2	500-S2	NS1334	140-S2		
					-101	-101	SURRY2	SURRY2
TRACE(99) 222RD-2	SURRY 2	3-201	025-S2	501-S2	NS1334	157-S2		
					-101	-101	SURRY2	SURRY2
TRACE(100) 223RD-2	SURRY 2	3-201	025-S2	502-S2	NS1334	194-S2		
					-101	-101	SURRY2	SURRY2
TRACE(101) 224RD-2	SURRY 2	2-201	025-S2	503-S2	NS1334	198-S2		
					-101	-101	SURRY2	SURRY2
TRACE(102) 225RD-2	SURRY 2	2-201	025-S2	505-S2	NS1351	287-S2		
					-101	-101	SURRY2	SURRY2
TRACE(103) 226RD-2	SURRY 2	3-201	025-S2	506-S2	NS1351	293-S2		
					-101	-101	SURRY2	SURRY2
TRACE(104) 227RD-2	SURRY 2	3-201	025-S2	508-S2	NS1353	373-S2		
					-101	-101	SURRY2	SURRY2

TRACE(105)	228RD-2	SURRY 2	3-201	025-S2	509-S2	NS1353 -101	354-S2 -101	SURRY2	SURRY2
TRACE(106)	229RD-2	SURRY 2	2-201	025-S2	510-S2	NS1353 -101	349-S2 -101	SURRY2	SURRY2
TRACE(107)	230RD-2	SURRY 2	3-201	025-S2	511-S2	NS1353 -101	387-S2 -101	SURRY2	SURRY2
TRACE(108)	231RD-2	SURRY 2	3-201	025-S2	512-S2	NS1357 -101	484-S2 -101	SURRY2	SURRY2
TRACE(109)	232RD-2	SURRY 2	2-201	025-S2	514-S2	NS1357 -101	445-S2 -101	SURRY2	SURRY2
TRACE(110)	233E-22X	ZORITA	3-101	-101	293	TLN-Z -101	-101 PSN-Z1	-101	-101
TRACE(111)	234E-22X	ZORITA	3-101	-101	383	TLN-Z -101	-101 PSN-Z2	-101	-101
TRACE(112)	235E-22X	ZORITA	3-101	-101	385	TLN-Z -101	-101 PSN-Z3	-101	-101
TRACE(113)	236E-22X	ZORITA	3-101	-101	313	TLN-Z -101	-101 PSN-Z4	-101	-101
TRACE(114)	237E-22X	ZORITA	3-101	-101	314	TLN-Z -101	-101 PSN-Z5	-101	-101
TRACE(115)	238E-22X	ZORITA	3-101	-101	316	TLN-Z -101	-101 PSN-Z6	-101	-101
TRACE(116)	239E-22X	ZORITA	3-101	-101	318	TLN-Z -101	-101 PSN-Z7	-101	-101
TRACE(117)	240E-22X	ZORITA	3-101	-101	387	TLN-Z -101	-101 PSN-Z8	-101	-101
TRACE(118)	241E-22X	ZORITA	3-101	-101	388	TLN-Z -101	-101 PSN-Z9	-101	-101
TRACE(119)	242E-22X	ZORITA	3-101	-101	294	TLN-Z -101	-101 PSN-Z10	-101	-101
TRACE(120)	243E-22X	ZORITA	3-101	-101	379	TLN-Z -101	-101 PSN-Z11	-101	-101
TRACE(121)	244E-22X	ZORITA	3-101	-101	384	TLN-Z -101	-101 PSN-Z12	-101	-101
TRACE(122)	245E-22X	ZORITA	3-101	-101	386	TLN-Z -101	-101 PSN-Z13	-101	-101
TRACE(123)	246E-23X	ZORITA	3-101	-101	330	TLN-Z -101	-101 PSN-Z14	-101	-101
TRACE(124)	247E-23X	ZORITA	3-101	-101	332	TLN-Z -101	-101 PSN-Z15	-101	-101
TRACE(125)	248E-23X	ZORITA	3-101	-101	362	TLN-Z -101	-101 PSN-Z16	-101	-101
TRACE(126)	249E-23X	ZORITA	3-101	-101	363	TLN-Z -101	-101 PSN-Z17	-101	-101

TRACE(127) 250E-23X	ZORITA	3-101	-101	364	TLN-Z -101	-101 PSN-Z18	-101	-101
TRACE(128) 251E-23X	ZORITA	3-101	-101	370	TLN-Z -101	-101 PSN-Z19	-101	-101
TRACE(129) 252E-23X	ZORITA	3-101	-101	371	TLN-Z -101	-101 PSN-Z20	-101	-101
TRACE(130) 253E-23X	ZORITA	3-101	-101	230	TLN-Z -101	-101 PSN-Z21	-101	-101
TRACE(131) 254E-23X	ZORITA	3-101	-101	334	TLN-Z -101	-101 PSN-Z22	-101	-101
TRACE(132) 255E-23X	ZORITA	3-101	-101	336	TLN-Z -101	-101 PSN-Z23	-101	-101
TRACE(133) 256E-23X	ZORITA	3-101	-101	344	TLN-Z -101	-101 PSN-Z24	-101	-101
TRACE(134) 2571D13	OCONEE 1	4FRGN-OC1-1	FRLN-OC1	08623	TLN-OC1-1 -101	-101 PSN-OC1-1	-101	-101
TRACE(135) 2581D13	OCONEE 1	4FRGN-OC1-2	FRLN-OC1	08634	TLN-OC1-1 -101	-101 PSN-OC1-1	-101	-101
TRACE(136) 2591D13	OCONEE 1	4FRGN-OC1-3	FRLN-OC1	08639	TLN-OC1-1 -101	-101 PSN-OC1-1	-101	-101
TRACE(137) 2601D13	OCONEE 1	4FRGN-OC1-1	FRLN-OC1	08640	TLN-OC1-1 -101	-101 PSN-OC1-1	-101	-101
TRACE(138) 2611D13	OCONEE 1	4FRGN-OC1-3	FRLN-OC1	08646	TLN-OC1-1 -101	-101 PSN-OC1-1	-101	-101
TRACE(139) 2621D13	OCONEE 1	4FRGN-OC1-3	FRLN-OC1	08647	TLN-OC1-1 -101	-101 PSN-OC1-1	-101	-101
TRACE(140) 2631D13	OCONEE 1	4FRGN-OC1-2	FRLN-OC1	08663	TLN-OC1-1 -101	-101 PSN-OC1-1	-101	-101
TRACE(141) 2641D13	OCONEE 1	4FRGN-OC1-2	FRLN-OC1	08672	TLN-OC1-1 -101	-101 PSN-OC1-1	-101	-101
TRACE(142) 2651D13	OCONEE 1	4FRGN-OC1-4	FRLN-OC1	08708	TLN-OC1-1 -101	-101 PSN-OC1-1	-101	-101
TRACE(143) 2661D13	OCONEE 1	4FRGN-OC1-3	FRLN-OC1	08734	TLN-OC1-1 -101	-101 PSN-OC1-1	-101	-101
TRACE(144) 2671D13	OCONEE 1	4FRGN-OC1-4	FRLN-OC1	08747	TLN-OC1-1 -101	-101 PSN-OC1-1	-101	-101
TRACE(145) 2681D13	OCONEE 1	4FRGN-OC1-2	FRLN-OC1	08751	TLN-OC1-1 -101	-101 PSN-OC1-1	-101	-101
TRACE(146) 2691D13	OCONEE 1	4FRGN-OC1-4	FRLN-OC1	09566	TLN-OC1-1 -101	-101 PSN-OC1-1	-101	-101
TRACE(147) 2701D13	OCONEE 1	4FRGN-OC1-2	FRLN-OC1	09603	TLN-OC1-1 -101	-101 PSN-OC1-1	-101	-101
TRACE(148) 2711D13	OCONEE 1	4FRGN-OC1-2	FRLN-OC1	09607	TLN-OC1-1 -101	-101 PSN-OC1-1	-101	-101

								-101	PSN-OC1-1	-101	-101
TRACE(150)	273ID054	OCONEE 1	3FRGN-OC1-6	FRLN-OC1	1[illegible]221	TLN-OC1-2	-101	-101	PSN-OC1-2	-101	-101
TRACE(151)	274ID054	OCONEE 1	3FRGN-OC1-5	FRLN-OC1	15547	TLN-OC1-2	-101	-101	PSN-OC1-2	-101	-101
TRACE(152)	275ID054	OCONEE 1	3FRGN-OC1-8	FRLN-OC1	15566	TLN-OC1-2	-101	-101	PSN-OC1-2	-101	-101
TRACE(153)	276ID054	OCONEE 1	3FRGN-OC1-8	FRLN-OC1	17272	TLN-OC1-2	-101	-101	PSN-OC1-2	-101	-101
TRACE(154)	277ID054	OCONEE 1	3FRGN-OC1-7	FRLN-OC1	17273	TLN-OC1-2	-101	-101	PSN-OC1-2	-101	-101
TRACE(155)	278ID054	OCONEE 1	3FRGN-OC1-7	FRLN-OC1	17297	TLN-OC1-2	-101	-101	PSN-OC1-2	-101	-101
TRACE(156)	279MT8099	MONTICELLO	6-101	FRLN-MC	BNC0905	TLN-MC	-101	-101	PSN-MC	PTN-MC1	SBN-MC1
TRACE(157)	280MT8099	MONTICELLO	6-101	FRLN-MC	BNH0559	TLN-MC	-101	-101	PSN-MC	PTN-MC2	SBN-MC2
TRACE(158)	281MT8099	MONTICELLO	6-101	FRLN-MC	BND1966	TLN-MC	-101	-101	PSN-MC	PTN-MC3	SBN-MC3
TRACE(159)	282MT8099	MONTICELLO	6-101	FRLN-MC	BNC0980	TLN-MC	-101	-101	PSN-MC	PTN-MC4	SBN-MC4
TRACE(160)	283MT8099	MONTICELLO	6-101	FRLN-MC	BNB0439	TLN-MC	-101	-101	PSN-MC	PTN-MC5	SBN-MC5
TRACE(161)	284MT8099	MONTICELLO	6-101	FRLN-MC	BNB0418	TLN-MC	-101	-101	PSN-MC	PTN-MC6	SBN-MC6
TRACE(162)	285MT8099	MONTICELLO	6-101	FRLN-MC	BNB0454	TLN-MC	-101	-101	PSN-MC	PTN-MC7	SBN-MC7
TRACE(163)	286MT8099	MONTICELLO	6-101	FRLN-MC	BNB0407	TLN-MC	-101	-101	PSN-MC	PTN-MC8	SBN-MC8
TRACE(164)	287MT8099	MONTICELLO	6-101	FRLN-MC	BNA0208	TLN-MC	-101	-101	PSN-MC	PTN-MC9	SBN-MC9
TRACE(165)	288MT8099	MONTICELLO	6-101	FRLN-MC	BNC0976	TLN-MC	-101	-101	PSN-MC	PTN-MC10	SBN-MC10
TRACE(166)	289MT8048	MONTICELLO	6-101	FRLN-MC	BND3675	TLN-MC	-101	-101	PSN-MC	PTN-MC11	SBN-MC11
TRACE(167)	290MT8048	MONTICELLO	6-101	FRLN-MC	BNH0363	TLN-MC	-101	-101	PSN-MC	PTN-MC12	SBN-MC12
TRACE(168)	291MT8048	MONTICELLO	6-101	FRLN-MC	BNA0114	TLN-MC	-101	-101	PSN-MC	PTN-MC13	SBN-MC13
TRACE(169)	292MT8048	MONTICELLO	6-101	FRLN-MC	BNB0119	TLN-MC	-101	-101	PSN-MC	PTN-MC14	SBN-MC14
TRACE(170)	293MT8048	MONTICELLO	6-101	FRLN-MC	BNE0481	TLN-MC	-101	-101	PSN-MC	PTN-MC15	SBN-MC15

APPENDIX C

RODRPT CODE OUTPUT LISTING FOR

TYPICAL ROD

PN	CALVERT CLIFFS 1	FRGN	-201	FGLN	CC1
PT	PWR	FRLN	CC1-05	FGS	-101
AN	CC1-RTC?	FRS	CC1-42	TLN	CC1-01

-PLN-	-PFN-	-PTN-
CC1-T4	CC1-165	CC1-T4
CC1-T4	CC1-166	CC1-T4
CC1-T4	CC1-167	CC1-T4
CC1-T4	CC1-168	CC1-T4
CC1-T4	CC1-192	CC1-T4
CC1-T4	CC1-195	CC1-T4
CC1-X4	CC1-196	CC1-T4
CC1-T4	CC1-197	CC1-T4

ARDI	0.0000	AEL	136.6650	APIEGA	-101.0000
APIC	0.0000	BP	464.7000	BT	-101.0000
CET	-101.0000	CSR	77.5600		
DDC	2000.0000	DT	257.0000	FAT	948.0000
GET	-101	GS	15.0000	H2IG	0.0000
H2IP	-101.0000	H2IPE	-101.0000	HEIG	-201.0000
HEIEGA	100.0000	HET	3227.0000	HIG	0.0000
HIPE	-101.0000	LSPL	.0630	MIG	0.0000
N2IP	-101.0000	NIEGA	-101.0000	NIG	0.0000
NIP	139.0000	NOS	0	NOP	176
OIG	0.0000	ORO	3.7000	OST	ABRADED
PBD	10.3050	PBCW	-101.0000	PCHD	-101.0000
PEI	.6500	PEOTUR	1.9990	PGD	10.1375
PL	0.6430	PLDD	.0150	PLDDI	.2915
PTD	.3725	PS	-101.0000	PTCW	-101.0000
PUDD	.0150	PUDDI	.2915	PV	.7340
RBD	10.3050	RHD	.5310	RCL	146.9340
TAN	29.0000	TE	.0043	TEL	136.6650
TIP	.3382	TISR	12.0000	TL	145.9000
TM	704	TOD	.4402	TOV	2.5000
TWT	.0260	UBIP	2.9260	UECIL	.0633
UEDI	.2500				

A2IEG	.0050	CIP	2506.6000
C2IEG	.0050	GAPF	.3003
C4IEG	.0050	MIP	-101.0000
H2IEG	.0050	REGP	.7260
HEIEG	98.4000	VEGP	18.1000
H3IEG	.0500		
K2IEG	.1700	GP	2.0400
N2IEG	.0050		
O2IEG	.0050		
XEIEG	1.4600		

ITI	HAFR	HAPR	HBU	HBYS	HU	HYS
750.0	-101.0	-101.0	-101.0	-101.[illegible]	52.8	37.0

-TOMPL-	--TIPL--		-XRL-	-YRL-	-FPL-
PIC1	761228	120000	11	14	146.93
TOC2	780122	220000	11	14	147.74
LOC2	790427	10000	14	11	147.69

NOLPT	0	NOSPT	2	NOTH	-201
APL	POI				

-ETCM-	--EIT--		-THETA-
EOC2	780122	220000	-201.000
EOC3	790420	120000	-201.000
-201	-201	-201	-201.000
			-201.000

	12.00	36.00	60.00	84.00	108.00	132.00
EXAMSP 1-1	.4372	.4366	.4367	.4369	.4369	.4385
1-2	.4382	.4375	.4377	.4382	.4388	.4400
2-1	.4362	.4359	.4365	.4370	.4369	.4381
2-2	.4378	.4371	.4375	.4380	.4380	.4398
3-1	-101.0000	-101.0000	-101.0000	-101.0000	-101.0000	-101.0000
3-2	-101.0000	-101.0000	-101.0000	-101.0000	-101.0000	-101.0000

PI	CVP
EFP?	1.066000E+13
NUAIC	217

-IACN-	-RCN-	---CIBT---		---CIET---	
1	1	741228	120000	761231	200000
2	2	770401	10000	780122	220000
3	3	780407	120000	790421	10000
4	4	790714	130000	801018	30000

	TIME	RSTSEC	REP	CCII	CCP	CCV
1	741223 120000	1	0.000	546.0	153.1	13.6
2	741230 10000	1	.035	546.0	153.1	13.6
3	741230 20000	1	0.000	546.0	153.1	13.6
4	750101 10000	2	0.000	546.0	153.1	13.6
5	750101 230000	2	0.000	546.0	153.1	13.6
6	750102 10000	2	.035	546.0	153.1	13.6
7	750102 230000	2	.035	546.0	153.1	13.6
8	750103 10000	2	0.000	546.0	153.1	13.6
9	750104 10000	2	0.000	546.0	153.1	13.6
10	750104 20000	2	.123	546.0	153.1	13.6
11	750105 10000	2	.239	546.0	153.1	13.6
12	750110 100000	2	.239	546.0	153.1	13.6
13	750110 180000	2	0.000	546.0	153.1	13.6
14	750111 20000	2	0.000	546.0	153.1	13.6
15	750113 180000	2	.239	546.0	153.1	13.6
16	750116 120000	2	.239	546.0	153.1	13.6
17	750116 230000	2	0.000	546.0	153.1	13.6
18	750118 150000	2	0.000	546.0	153.1	13.6
19	750119 230000	2	.234	546.0	153.1	13.6
20	750120 10000	2	0.000	546.0	153.1	13.6
21	750120 120000	2	.190	546.0	153.1	13.6
22	750120 230000	2	0.000	546.0	153.1	13.6
23	750121 10000	2	.234	546.0	153.1	13.6
24	750122 10000	2	.284	546.0	153.1	13.6
25	750122 60000	2	.373	546.0	153.1	13.6
26	750124 10000	2	.474	546.0	153.1	13.6
27	750126 230000	2	.474	546.0	153.1	13.6
28	750127 10000	2	0.000	546.0	153.1	13.6
29	750209 230000	2	0.000	546.0	153.1	13.6
30	750210 10000	2	.474	546.0	153.1	13.6
31	750218 120000	2	.474	546.0	153.1	13.6
32	750218 180000	2	0.000	546.0	153.1	13.6
33	750219 120000	2	0.000	546.0	153.1	13.6
34	750219 230000	2	.474	546.0	153.1	13.6
35	750224 110000	2	.474	546.0	153.1	13.6
36	750226 120000	2	0.000	546.0	153.1	13.6
37	750226 180000	2	0.000	546.0	153.1	13.6
38	750226 230000	2	.047	546.0	153.1	13.6
39	750227 120000	2	.047	546.0	153.1	13.6
40	750227 180000	2	.474	546.0	153.1	13.6
41	750302 10000	2	.474	546.0	153.1	13.6
42	750302 180000	2	0.000	546.0	153.1	13.6
43	750303 60000	2	0.000	546.0	153.1	13.6
44	750303 110000	2	.474	546.0	153.1	13.6
45	750303 230000	2	.474	546.0	153.1	13.6
46	750304 10000	2	0.000	546.0	153.1	13.6
47	750304 120000	2	.474	546.0	153.1	13.6
48	750306 230000	3	.474	546.0	153.1	13.6
49	750307 10000	3	0.000	546.0	153.1	13.6
50	750311 120000	3	0.000	546.0	153.1	13.6

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	TIMEFP	FSTS	PRSP	NASP 1	NASP 2	NASP 3	NASP 4	NASP 5	NASP 6
1	761229 120000	1	10.90	.506	.849	.982	.979	.867	.498
2	761230 120000	2	11.62	.473	.835	.988	.942	.784	.455
3	750305 120000	3	11.73	.473	.837	.988	.936	.778	.451
4	750427 120000	4	11.57	.464	.824	.984	.949	.784	.447
5	750613 120000	5	10.98	.491	.844	.985	.966	.829	.491
6	750722 120000	6	10.49	.523	.862	.986	.984	.866	.530
7	750916 120000	7	10.15	.556	.878	.986	.995	.904	.577
8	751022 120000	8	9.79	.603	.904	.985	.998	.934	.628
9	751126 120000	9	9.52	.644	.925	.980	.994	.957	.673
10	751230 120000	10	9.54	.666	.889	.928	.965	.983	.737
11	760309 120000	11	9.13	.743	.969	.955	.963	.986	.759
12	760424 120000	12	9.11	.806	.990	.970	.917	.962	.785
13	760527 120000	13	9.19	.940	.932	.867	.864	.961	.812
14	760903 120000	14	9.19	.935	.977	.833	.837	.973	.825
15	761210 120000	15	9.26	.718	.924	.783	.806	.975	.764
16	770422 120000	16	6.72	.754	.977	.975	.964	.989	.784
17	770513 120000	17	6.72	.754	.970	.961	.954	.990	.792
18	770623 120000	18	6.77	.746	.953	.940	.939	.992	.803
19	770726 120000	19	6.77	.765	.989	.949	.925	.959	.770
20	770927 120000	20	6.69	.787	.989	.951	.936	.988	.802
21	770929 120000	21	6.79	.794	.990	.940	.929	.966	.784
22	771133 120000	22	6.77	.796	.991	.942	.925	.977	.775
23	771205 120000	23	6.81	.797	.991	.945	.943	.964	.759
24	780403 120000	24	6.21	.575	.826	.937	.992	.951	.688
25	780506 120000	25	5.98	.653	.892	.971	.947	.946	.697
26	780601 120000	26	5.91	.696	.927	.980	.947	.938	.701
27	780706 120000	27	5.76	.731	.939	.987	.909	.955	.730
28	780811 120000	28	5.63	.777	.966	.993	.998	.970	.775
29	780915 120000	29	5.54	.793	.976	.993	.996	.977	.795
30	781010 120000	30	5.69	.832	.990	.975	.953	.928	.761
31	781123 120000	31	5.68	.837	.994	.973	.956	.944	.782
32	790130 120000	32	5.62	.917	.975	.971	.979	.931	.833
33	790304 120000	33	5.67	.839	.992	.970	.962	.967	.812
34	790407 120000	34	5.64	.819	.966	.976	.982	.990	.826
35	790427 120000	35	5.76	.843	.992	.964	.951	.949	.791

APPENDIX D

DATAGIN SUBROUTINE OUTPUT LISTING

FOR TYPICAL ROD

```
NRUP= 170   RN=CALVERT CLIFFS 1   AN=CC1-RT03        FRS=CC1-42          RT=PWR

 *DESGAPP=   .72927E+C1*PRDF=        .94924E+02*ARDIP=    0.            *DPD=       .37000E+01*PS=          -.10100E+03*TDV=         .25000E+01
 *PPA=       .66470E+02*GS=          .15000E+02                          *CEI=      -.10100E+03*HEI=        .32270E+04*ARIG=        0.
 *NOCI=                3*ARIFGA=    -.10100E+03*H2IG=     0.            *HETFGA=    .10000E+03*HETG=      -.20100E+03*HIG=         0.
 *PIG=       0.          *NIFGA=    -.10100E+03*NIG=      0.            *DIG=       0.         *VFUEL=       .15247E+02*H2IPE=      -.10100E+03
 *NIP=       .13200E+03                                                  *GET=      -101         *GPA=         .29988E+02*FGFRAC=      .16300E+01
 *HEFRAC=    .98400E+02*DGFRAC=      .80000E-01*PFGR=       .27000E+0C*DELPRT=   -.17859E+04*PEDTUR=      .19990E+01*PCHD=        0.
 *TOTLF=     .11390E+02*PL=          .86430E+01*CPDT=       .79654E+01*HYS=       .37000E+02*DSHVFRC=     .13664E-01*CHMVFRC=     0.
 *PEL=       .65000E+00*TAN=         .29000E+02*TL=         .40000E-02*PCHD=      0.           *ASRIN =      .77560E-34*TISRIX =     .13003E-06
 *ITTS=      .75000E+03*POD=         .37950E+03*N901=                   31*JPDW=              1098*LCYCLE=                1*HRSUP(JPDW)=   30145.0
 NOCT      ALHRCY       PLHRCY        ABUEDC       PRUEDC       CYUPHRS      CYCUFUP

   1  .70787E+C1  .11160E+02  .23158E+05  .25578E+05  .15643E+05  .15643E+05
   2  .19361E+01  .89264E+01  .25919E+05  .28613E+05  .68370E+04  .22280E+0*
   3  .69712E+C1  .84880E+01  .37534E+05  .40930E+05  .78650E+04  .30145E+05
 NODE  ALLHRCY1   ALLHRCY2   ALLHRCY3   ALLHRCY4   ALLHRCY5   ALLHRCY6   LBUEDC1    LBUEDC2    LBUEDC3    LBUEDC4    LBUEDC5    LBUEDC6

   1 .56893E+01 .15684E+C1 .60025E+01 ********** ********** ********** .18613E+05 .20894E+05 .30885E+05 ********** ********** **********
   2 .77524E+01 .20241E+01 .74071E+01 ********** ********** ********** .25342E+05 .28238E+05 .40650E+05 ********** ********** **********
   3 .77176E+C1 .20425E+01 .75377E+01 ********** ********** ********** .25248E+05 .28207E+05 .40766E+05 ********** ********** **********
   4 .77298E+01 .20533E+01 .75579E+01 ********** ********** ********** .25275E+05 .28242E+05 .40842E+05 ********** ********** **********
   5 .78193E+01 .20954E+01 .73925E+01 ********** ********** ********** .25578E+05 .28613E+05 .40930E+05 ********** ********** **********
   6 .57686E+01 .15629E+01 .59297E+01 ********** ********** ********** .18872E+05 .21937E+05 .31131E+05 ********** ********** **********
 NRL     ITRL(DATE)  ITRL(TIME)     TOMRL        ECYPP1

   1        -101         -101         -101 -.10100E+03
   2      780122       220000         EOC2  .54855E+00
   3        -101         -101         -101 -.10100E+03
 NFL     ITFL(DATE)  ITFL(TIME)     TOMFL        EFXRP

   1        -101         -101         -101 -.10100E+03
   2        -101         -101         -101 -.10100E+03
   3        -101         -101         -101 -.10100E+03
      EIT1(D)EIT1(T)ETOM1*EIT2(D)EIT2(T)ETOM2*EIT3(D)EIT3(T)ETOM3*EIT4(D)EIT4(T)ETOM4*EIT5(D)EIT5(T)ETOM5*EIT6(D)EIT6(D)ETOM6*

      -101    -101   -101*780122 220000   EOC2*790420 120000   EOC3*
 NODE       MECRPSF1      *      MECRPSF2      *      MECRPSF3      *      MECRPSF4      *      MECRPSF5      *      MECRPSF6      *

   1     -.10100E+03      *   -.56792E+00      *   -.72410E+00      *
   2     -.10100E+03      *   -.72410E+00      *   -.84337E+00      *
   3     -.10100E+03      *   -.68435E+00      *   -.73262E+00      *
   4     -.10100E+03      *   -.60768E+00      *   -.61620E+00      *
   5     -.10100E+03      *   -.53669E+00      *   -.62472E+00      *
   6     -.10100E+03      *   -.22149E+00      *   -.27828E+00      *
      EIT1(D)EIT1(T)ETOM1*EIT2(D)EIT2(T)ETOM2*EIT3(D)EIT3(T)ETOM3*EIT4(D)EIT4(T)ETOM4*EIT5(D)EIT5(T)ETOM5*EIT6(D)EIT6(D)ETOM6*

      -101    -101   -101*780122 220000   EOC2*790420 120000   EOC3*
 NODE       MECRPLF1      *      MECRPLF2      *      MECRPLF3      *      MECRPLF4      *      MECRPLF5      *      MECRPLF6      *

   1     -.10100E+03      *   -.10100E+03      *   -.10100E+03      *
   2     -.10100E+03      *   -.10100E+03      *   -.10100E+03      *
   3     -.10100E+03      *   -.10100E+03      *   -.10100E+03      *
   4     -.10100E+03      *   -.10100E+03      *   -.10100E+03      *
   5     -.10100E+03      *   -.10100E+03      *   -.10100E+03      *
   6     -.10100E+03      *   -.10100E+03      *   -.10100E+03      *

 N2=    16
```

APPENDIX E

DATAN CODE OUTPUT LISTING SAMPLE FOR TYPICAL

RUN

```
********************************************************  GRE  ********************************************************

(GRE ROD NO,GRE ROD ID)
( 001, 002),( 002, 008),( 003, 009),( 004, 010),( 005, 011),( 006, 013),( 007, 014),( 008, 015),( 009, 021),( 010, 022),
( 011, 026),( 012, 029),( 013, 030),( 014, 031),( 015, 032),( 016, 033),( 017, 035),( 018, 036),( 019, 037),( 020, 038),
( 021, 052),( 022, 053),( 023, 055),( 024, 057),( 025, 058),( 026, 061),( 027, 063),( 028, 065),( 029, 084),( 030, 085),
( 031, 086),( 032, 087),( 033, 088),( 034, 089),( 035, 090),( 036, 091),( 037, 092),( 038, 093),( 039, 094),( 040, 095),
( 041, 096),( 042, 097),( 043, 098),( 044, 099),( 045, 100),( 046, 101),( 047, 102),( 048, 103),( 049, 104),( 050, 105),
( 051, 106),( 052, 107),( 053, 108),( 054, 109),( 055, 110),( 056, 111),( 057, 112),( 058, 113),( 059, 114),( 060, 115),
( 061, 116),( 062, 118),( 063, 139),( 064, 142),( 065, 143),( 066, 144),( 067, 145),( 068, 146),( 069, 147),( 070, 148),
( 071, 152),( 072, 153),( 073, 154),( 074, 155),( 075, 169),( 076, 170),( 077, 171),( 078, 172),( 079, 173),( 080, 174),
( 081, 175),( 082, 186),( 083, 187),( 084, 188),( 085, 189),( 086, 190),( 087, 191),( 088, 192),( 089, 215),( 090, 233),
( 091, 234),( 092, 235),( 093, 236),( 094, 237),( 095, 238),( 096, 239),( 097, 240),( 098, 241),( 099, 242),( 100, 243),
( 101, 244),( 102, 245),( 103, 246),( 104, 247),( 105, 249),( 106, 250),( 107, 251),( 108, 252),( 109, 253),( 110, 254),
( 111, 255),( 112, 257),( 113, 258),( 114, 259),( 115, 260),( 116, 261),( 117, 262),( 118, 263),( 119, 264),( 120, 265),
( 121, 266),( 122, 267),( 123, 268),( 124, 270),( 125, 271),( 126, 272),( 127, 273),( 128, 274),( 129, 275),( 130, 276),
( 131, 277),( 132, 278)

(GRE PT. NO,GRE ROD ID)
( 001, 002),( 002, 008),( 003, 009),( 004, 010),( 005, 011),( 006, 013),( 007, 014),( 008, 015),( 009, 021),( 010, 022),
( 011, 026),( 012, 029),( 013, 030),( 014, 031),( 015, 032),( 016, 033),( 017, 035),( 018, 036),( 019, 037),( 020, 038),
( 021, 052),( 022, 053),( 023, 055),( 024, 057),( 025, 058),( 026, 061),( 027, 063),( 028, 065),( 029, 084),( 030, 085),
( 031, 086),( 032, 087),( 033, 088),( 034, 089),( 035, 090),( 036, 091),( 037, 092),( 038, 093),( 039, 094),( 040, 095),
( 041, 096),( 042, 097),( 043, 098),( 044, 099),( 045, 100),( 046, 101),( 047, 102),( 048, 103),( 049, 104),( 050, 105),
( 051, 106),( 052, 107),( 053, 108),( 054, 109),( 055, 110),( 056, 111),( 057, 112),( 058, 113),( 059, 114),( 060, 115),
( 061, 116),( 062, 118),( 063, 139),( 064, 142),( 065, 143),( 066, 144),( 067, 145),( 068, 146),( 069, 147),( 070, 148),
( 071, 152),( 072, 153),( 073, 154),( 074, 155),( 075, 169),( 076, 170),( 077, 171),( 078, 172),( 079, 173),( 080, 174),
( 081, 175),( 082, 186),( 083, 187),( 084, 188),( 085, 189),( 086, 190),( 087, 191),( 088, 192),( 089, 215),( 090, 233),
( 091, 234),( 092, 235),( 093, 236),( 094, 237),( 095, 238),( 096, 239),( 097, 240),( 098, 241),( 099, 242),( 100, 243),
( 101, 244),( 102, 245),( 103, 246),( 104, 247),( 105, 249),( 106, 250),( 107, 251),( 108, 252),( 109, 253),( 110, 254),
( 111, 256),( 112, 257),( 113, 258),( 114, 259),( 115, 260),( 116, 261),( 117, 262),( 118, 263),( 119, 264),( 120, 265),
( 121, 266),( 122, 267),( 123, 268),( 124, 270),( 125, 271),( 126, 272),( 127, 273),( 128, 274),( 129, 275),( 130, 276),
( 131, 277),( 132, 278)

GRE RODS =132   GRE PTS = 132

NO. LO,MED, HI BURNUP GRE PTS =     16    68    48

NO. LO,MED,HI POWER GRE PTS =     13    73    49

NO.OLD AND NEW DESIGN GRE PT(BO,BN,PO,PN)=     32     6    94     0

NO.PTS.PER GRE SUBINTERVAL=     86     1    14    15    15     1

NO.LO,MED,HI BU PTS PER GRE SUBINTERVAL
     8     0     7     1     0     0
    40     0     6    12    10     0
    38     1     1     2     5     1

NO.LO,MED,HI POWER PTS PER GRE SUBINTERVAL
     5     0     4     1     0     0
    43     0     8    12    10     0
    38     1     2     2     5     1

NO.OLD AND NEW B&R AND P&R RODS PER GRE SUBINTERVAL
     8     0     4    10    10     0
     2     0     2     2     3     0
    76     1     8     3     5     1
     0     0     0     0     0     0

PT   RD     GRE(J          BUID         MALHRID
```

```
******************************************************* HEF *********************************************************

(HEF ROD NO,HEF ROD ID)
( 001, 002),( 002, 010),( 003, 011),( 004, 013),( 005, 014),( 006, 015),( 007, 021),( 008, 022),( 009, 026),( 010, 027),
( 011, 028),( 012, 029),( 013, 030),( 014, 031),( 015, 032),( 016, 033),( 017, 035),( 018, 036),( 019, 037),( 020, 038),
( 021, 052),( 022, 053),( 023, 055),( 024, 057),( 025, 058),( 026, 061),( 027, 063),( 028, 065),( 029, 084),( 030, 085),
( 031, 086),( 032, 087),( 033, 088),( 034, 089),( 035, 090),( 036, 091),( 037, 092),( 038, 093),( 039, 094),( 040, 095),
( 041, 096),( 042, 097),( 043, 098),( 044, 099),( 045, 100),( 046, 101),( 047, 102),( 048, 103),( 049, 104),( 050, 105),
( 051, 106),( 052, 107),( 053, 108),( 054, 109),( 055, 110),( 056, 111),( 057, 112),( 058, 113),( 059, 114),( 060, 115),
( 061, 118),( 062, 139),( 063, 142),( 064, 143),( 065, 144),( 066, 145),( 067, 146),( 068, 147),( 069, 148),( 070, 169),
( 071, 170),( 072, 171),( 073, 172),( 074, 186),( 075, 187),( 076, 188),( 077, 189),( 078, 190),( 079, 191),( 080, 192),
( 081, 215),( 082, 234),( 083, 235),( 084, 236),( 085, 237),( 086, 238),( 087, 239),( 088, 240),( 089, 241),( 090, 242),
( 091, 243),( 092, 244),( 093, 245),( 094, 246),( 095, 247),( 096, 249),( 097, 250),( 098, 251),( 099, 252),( 100, 253),
( 101, 254),( 102, 256)

(HEF PT. NO,HEF ROD ID)
( 001, 002),( 002, 010),( 003, 011),( 004, 013),( 005, 014),( 006, 015),( 007, 021),( 008, 022),( 009, 026),( 010, 027),
( 011, 028),( 012, 029),( 013, 030),( 014, 031),( 015, 032),( 016, 033),( 017, 035),( 018, 036),( 019, 037),( 020, 038),
( 021, 052),( 022, 053),( 023, 055),( 024, 057),( 025, 058),( 026, 061),( 027, 063),( 028, 065),( 029, 084),( 030, 085),
( 031, 086),( 032, 087),( 033, 088),( 034, 089),( 035, 090),( 036, 091),( 037, 092),( 038, 093),( 039, 094),( 040, 095),
( 041, 096),( 042, 097),( 043, 098),( 044, 099),( 045, 100),( 046, 101),( 047, 102),( 048, 103),( 049, 104),( 050, 105),
( 051, 106),( 052, 107),( 053, 108),( 054, 109),( 055, 110),( 056, 111),( 057, 112),( 058, 113),( 059, 114),( 060, 115),
( 061, 118),( 062, 139),( 063, 142),( 064, 143),( 065, 144),( 066, 145),( 067, 146),( 068, 147),( 069, 148),( 070, 169),
( 071, 170),( 072, 171),( 073, 172),( 074, 186),( 075, 187),( 076, 188),( 077, 189),( 078, 190),( 079, 191),( 080, 192),
( 081, 215),( 082, 234),( 083, 235),( 084, 236),( 085, 237),( 086, 238),( 087, 239),( 088, 240),( 089, 241),( 090, 242),
( 091, 243),( 092, 244),( 093, 245),( 094, 246),( 095, 247),( 096, 249),( 097, 250),( 098, 251),( 099, 252),( 100, 253),
( 101, 254),( 102, 256)

HEF RODS =102   HEF PTS = 102

NO. LO,MED, HI BURNUP HEF PTS =     17    58    27

NO. LO,MED,HI POWER HEF PTS =     10    65    27

NO.OLD AND NEW DESIGN HEF PT(BO,BN,PO,PN)=    34     2    66     0

NO.PTS.PER HEF SUBINTERVAL=    26    17     1     4     5    49

NO.LO,MED,HI BU PTS PER HEF SUBINTERVAL
    3     6     0     1     2     5
   17     7     1     1     1    31
    6     4     0     2     2    13

NO.LO,MED,HI POWER PTS PER HEF SUBINTERVAL
    2     3     0     0     2     3
   18    13     1     2     1    30
    6     1     0     2     2    16

NO.OLD AND NEW BWR AND PWR RODS PER HEF SUBINTERVAL
   18     7     1     2     1     5
    0     0     0     0     0     2
    8    10     0     2     4    42
    0     0     0     0     0     0

 PT  RD    HEF2D          BU2D          MALHR2D

  1   2  .99100E+02    .33441E+05    .63830E+01
  2  10  .98600E+02    .33329E+05    .64202E+01
  3  11  .99450E+02    .18718E+05    .56600E+01
  4  13  .99040E+02    .21591E+05    .65765E+01
  5  14  .99530E+02    .18670E+05    .56543E+01
  6  15  .99260E+02    .25824E+05    .61563E+01
```

```
*********************************************** ZRO ***********************************************

(ZRO ROD NO,ZRO ROD ID)
( 001, 004),( 002, 005),( 003, 007),( 004, 009),( 005, 019),( 006, 020),( 007, 170),( 008, 171),( 009, 172),( 010, 173),
( 011, 174),( 012, 175),( 013, 180),( 014, 183),( 015, 234),( 016, 235),( 017, 236),( 018, 240),( 019, 242),( 020, 244),
( 021, 245),( 022, 246),( 023, 249),( 024, 250),( 025, 251),( 026, 252),( 027, 253),( 028, 254),( 029, 259),( 030, 263),
( 031, 264),( 032, 273),( 033, 274),( 034, 279),( 035, 280),( 036, 281),( 037, 282),( 038, 283),( 039, 284),( 040, 285),
( 041, 286),( 042, 287),( 043, 288),( 044, 289),( 045, 290),( 046, 291),( 047, 292),( 048, 293)

(ZRO PT. NO,ZRO ROD ID)
( 001, 004),( 002, 004),( 003, 004),( 004, 004),( 005, 004),( 006, 004),( 007, 005),( 008, 005),( 009, 005),( 010, 005),
( 011, 005),( 012, 005),( 013, 007),( 014, 007),( 015, 007),( 016, 007),( 017, 007),( 018, 007),( 019, 009),( 020, 009),
( 021, 009),( 022, 009),( 023, 009),( 024, 009),( 025, 019),( 026, 019),( 027, 019),( 028, 019),( 029, 019),( 030, 019),
( 031, 020),( 032, 020),( 033, 023),( 034, 020),( 035, 020),( 036, 023),( 037, 170),( 038, 170),( 039, 170),( 040, 171),
( 041, 172),( 042, 173),( 043, 173),( 044, 173),( 045, 173),( 046, 173),( 047, 173),( 048, 174),( 049, 174),( 050, 174),
( 051, 174),( 052, 174),( 053, 174),( 054, 175),( 055, 175),( 056, 175),( 057, 175),( 058, 175),( 059, 175),( 060, 180),
( 061, 180),( 062, 180),( 063, 180),( 064, 180),( 065, 180),( 066, 183),( 067, 183),( 068, 183),( 069, 183),( 070, 183),
( 071, 183),( 072, 234),( 073, 234),( 074, 234),( 075, 234),( 076, 234),( 077, 235),( 078, 235),( 079, 235),( 080, 235),
( 081, 235),( 082, 236),( 083, 236),( 084, 236),( 085, 240),( 086, 240),( 087, 240),( 088, 242),( 089, 242),( 090, 242),
( 091, 242),( 092, 242),( 093, 244),( 094, 245),( 095, 245),( 096, 245),( 097, 246),( 098, 246),( 099, 246),( 100, 245),
( 101, 246),( 102, 249),( 103, 249),( 104, 249),( 105, 249),( 106, 250),( 107, 250),( 108, 250),( 109, 251),( 110, 251),
( 111, 251),( 112, 252),( 113, 252),( 114, 252),( 115, 253),( 116, 253),( 117, 253),( 118, 254),( 119, 254),( 120, 259),
( 121, 263),( 122, 264),( 123, 264),( 124, 264),( 125, 273),( 126, 273),( 127, 273),( 128, 274),( 129, 274),( 130, 279),
( 131, 279),( 132, 279),( 133, 279),( 134, 279),( 135, 279),( 136, 280),( 137, 280),( 138, 280),( 139, 280),( 140, 280),
( 141, 280),( 142, 281),( 143, 281),( 144, 281),( 145, 281),( 146, 281),( 147, 281),( 148, 282),( 149, 282),( 150, 282),
( 151, 282),( 152, 282),( 153, 282),( 154, 283),( 155, 283),( 156, 283),( 157, 283),( 158, 283),( 159, 283),( 160, 284),
( 161, 284),( 162, 284),( 163, 284),( 164, 284),( 165, 284),( 166, 285),( 167, 285),( 168, 285),( 169, 285),( 170, 285),
( 171, 285),( 172, 286),( 173, 286),( 174, 286),( 175, 286),( 176, 286),( 177, 286),( 178, 287),( 179, 287),( 180, 287),
( 181, 287),( 182, 287),( 183, 287),( 184, 288),( 185, 288),( 186, 288),( 187, 288),( 188, 288),( 189, 288),( 190, 289),
( 191, 289),( 192, 289),( 193, 289),( 194, 289),( 195, 289),( 196, 290),( 197, 290),( 198, 290),( 199, 290),( 200, 290),

( 201, 290),( 202, 291),( 203, 291),( 204, 291),( 205, 291),( 206, 291),( 207, 291),( 208, 292),( 209, 292),( 210, 292),
( 211, 292),( 212, 292),( 213, 292),( 214, 293),( 215, 293),( 216, 293),( 217, 293),( 218, 293),( 219, 293)

ZRO RODS = 48   ZRO PTS = 219

NO. LO,MED, HI BURNUP ZRO PTS =      0    71   148

NO. LO,MED,HI POWER ZRO PTS =   102    96    19

NO.OLD AND NEW DESIGN ZRO PT(BO,BN,PO,PN)=      0    90   129     0

NO.PTS.PER ZRO SUBINTERVAL=    41    76    72    25     4     1

NO.LO,MED,HI BU PTS PER ZRO SUBINTERVAL
     0     3     0     0     0     0
    15    23    24     7     1     1
    26    53    48    18     3     0

NO.LO,MED,HI POWER PTS PER ZRO SUBINTERVAL
    15    29    39    16     2     1
    21    34    30     9     2     0
     4    12     3     0     0     0

NO.OLD AND NEW BWR AND PWR RODS PER ZRO SUBINTERVAL
     0     0     0     0     0     0
     7    28    31    20     3     1
    34    48    41     5     1     0
     0     0     0     0     0     0

 PT  RD     ZRO3D          LBU3D         LLHR3D
```

```
******************************************************* ECR ****************************************************

(ECR ROD NO.,ECR ROD ID)
( 001, 001),( 002, 002),( 003, 003),( 004, 004),( 005, 005),( 006, 006),( 007, 007),( 008, 008),( 009, 009),( 010, 010),
( 011, 011),( 012, 012),( 013, 013),( 014, 014),( 015, 015),( 016, 016),( 017, 017),( 018, 018),( 019, 019),( 020, 020),
( 021, 021),( 022, 023),( 023, 024),( 024, 025),( 025, 029),( 026, 030),( 027, 034),( 028, 035),( 029, 036),( 030, 037),
( 031, 038),( 032, 039),( 033, 040),( 034, 041),( 035, 042),( 036, 043),( 037, 044),( 038, 045),( 039, 046),( 040, 047),
( 041, 048),( 042, 049),( 043, 050),( 044, 051),( 045, 052),( 046, 053),( 047, 054),( 048, 055),( 049, 056),( 050, 057),
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( 081, 121),( 082, 122),( 083, 123),( 084, 124),( 085, 125),( 086, 126),( 087, 127),( 088, 128),( 089, 129),( 090, 130),
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( 141, 202),( 142, 203),( 143, 204),( 144, 205),( 145, 206),( 146, 207),( 147, 208),( 148, 209),( 149, 210),( 150, 211),
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( 181, 263),( 182, 264),( 183, 265),( 184, 266),( 185, 267),( 186, 268),( 187, 269),( 188, 270),( 189, 271),( 190, 272),
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( 211, 293)

(ECR PT. NO.,ECR ROD ID)
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( 021, 002),( 022, 002),( 023, 002),( 024, 002),( 025, 003),( 026, 003),( 027, 003),( 028, 003),( 029, 003),( 030, 003),
( 031, 003),( 032, 003),( 033, 003),( 034, 003),( 035, 003),( 036, 003),( 037, 004),( 038, 004),( 039, 004),( 040, 004),
( 041, 004),( 042, 004),( 043, 005),( 044, 005),( 045, 005),( 046, 005),( 047, 005),( 048, 005),( 049, 006),( 050, 006),
( 051, 006),( 052, 006),( 053, 006),( 054, 006),( 055, 006),( 056, 006),( 057, 006),( 058, 006),( 059, 006),( 060, 006),
( 061, 007),( 062, 007),( 063, 007),( 064, 007),( 065, 007),( 066, 007),( 067, 007),( 068, 007),( 069, 007),( 070, 007),
( 071, 007),( 072, 007),( 073, 008),( 074, 008),( 075, 008),( 076, 008),( 077, 008),( 078, 008),( 079, 008),( 080, 008),
( 081, 008),( 082, 008),( 083, 008),( 084, 008),( 085, 009),( 086, 009),( 087, 009),( 088, 009),( 089, 009),( 090, 009),
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( 101, 010),( 102, 010),( 103, 010),( 104, 010),( 105, 010),( 106, 010),( 107, 010),( 108, 010),( 109, 011),( 110, 011),
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( 141, 016),( 142, 016),( 143, 016),( 144, 016),( 145, 017),( 146, 017),( 147, 017),( 148, 017),( 149, 017),( 150, 017),
( 151, 018),( 152, 018),( 153, 018),( 154, 018),( 155, 018),( 156, 018),( 157, 019),( 158, 019),( 159, 019),( 160, 019),
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( 201, 030),( 202, 030),( 203, 030),( 204, 034),( 205, 034),( 206, 034),( 207, 034),( 208, 034),( 209, 034),( 210, 035),
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( 221, 036),( 222, 037),( 223, 037),( 224, 037),( 225, 037),( 226, 037),( 227, 037),( 228, 038),( 229, 038),( 230, 038),
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( 251, 040),( 252, 040),( 253, 040),( 254, 040),( 255, 040),( 256, 040),( 257, 041),( 258, 041),( 259, 041),( 260, 041),
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( 271, 042),( 272, 042),( 273, 042),( 274, 042),( 275, 042),( 276, 042),( 277, 042),( 278, 042),( 279, 042),( 280, 042),
( 281, 043),( 282, 043),( 283, 043),( 284, 043),( 285, 043),( 286, 043),( 287, 043),( 288, 043),( 289, 043),( 290, 043),
( 291, 043),( 292, 043),( 293, 044),( 294, 044),( 295, 044),( 296, 044),( 297, 044),( 298, 044),( 299, 044),( 300, 044),
( 301, 044),( 302, 044),( 303, 044),( 304, 044),( 305, 045),( 306, 045),( 307, 045),( 308, 045),( 309, 045),( 310, 045),
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(ECX ROD NO,ECX ROD ID)
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( 011, 011),( 012, 012),( 013, 013),( 014, 014),( 015, 015),( 016, 016),( 017, 017),( 018, 018),( 019, 019),( 020, 020),
( 021, 021),( 022, 022),( 023, 023),( 024, 024),( 025, 068),( 026, 069),( 027, 070),( 028, 071),( 029, 072),( 030, 074),
( 031, 121),( 032, 122),( 033, 133),( 034, 134),( 035, 135),( 036, 136),( 037, 137),( 038, 138),( 039, 169),( 040, 170),
( 041, 171),( 042, 172),( 043, 173),( 044, 175),( 045, 176),( 046, 178),( 047, 179),( 048, 180),( 049, 181),( 050, 182),
( 051, 183),( 052, 184),( 053, 185),( 054, 217),( 055, 218),( 056, 219),( 057, 220),( 058, 233),( 059, 234),( 060, 235),
( 061, 236),( 062, 237),( 063, 238),( 064, 239),( 065, 240),( 066, 241),( 067, 242),( 068, 243),( 069, 244),( 070, 245),
( 071, 246),( 072, 247),( 073, 248),( 074, 249),( 075, 250),( 076, 251),( 077, 252),( 078, 254),( 079, 255),( 080, 256),
( 081, 257),( 082, 258),( 083, 259),( 084, 260),( 085, 261),( 086, 262),( 087, 263),( 088, 264),( 089, 265),( 090, 266),
( 091, 257),( 092, 268),( 093, 269),( 094, 270),( 095, 271),( 096, 272),( 097, 279),( 098, 280),( 099, 281),( 100, 282),
( 101, 283),( 102, 284),( 103, 285),( 104, 286),( 105, 287),( 106, 288),( 107, 289),( 108, 290),( 109, 291),( 110, 292),
( 111, 293)

(ECX PT. NO,ECX ROD ID)
( 001, 001),( 002, 001),( 003, 002),( 004, 002),( 005, 003),( 006, 003),( 007, 004),( 008, 005),( 009, 006),( 010, 006),
( 011, 007),( 012, 007),( 013, 008),( 014, 008),( 015, 009),( 016, 009),( 017, 010),( 018, 010),( 019, 011),( 020, 012),
( 021, 013),( 022, 014),( 023, 015),( 024, 016),( 025, 017),( 026, 018),( 027, 019),( 028, 020),( 029, 021),( 030, 022),
( 031, 023),( 032, 024),( 033, 068),( 034, 068),( 035, 069),( 036, 070),( 037, 071),( 038, 072),( 039, 074),( 040, 121),
( 041, 121),( 042, 122),( 043, 122),( 044, 133),( 045, 133),( 046, 134),( 047, 134),( 048, 135),( 049, 135),( 050, 136),
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( 061, 175),( 062, 176),( 063, 178),( 064, 179),( 065, 180),( 066, 181),( 067, 182),( 068, 183),( 069, 184),( 070, 185),
( 071, 185),( 072, 217),( 073, 217),( 074, 218),( 075, 218),( 076, 219),( 077, 219),( 078, 220),( 079, 220),( 080, 233),
( 081, 233),( 082, 234),( 083, 235),( 084, 235),( 085, 235),( 086, 236),( 087, 237),( 088, 238),( 089, 239),( 090, 240),
( 091, 241),( 092, 242),( 093, 242),( 094, 243),( 095, 243),( 096, 243),( 097, 244),( 098, 245),( 099, 245),( 100, 246),
( 101, 246),( 102, 247),( 103, 247),( 104, 248),( 105, 248),( 106, 249),( 107, 250),( 108, 251),( 109, 252),( 110, 254),
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( 151, 286),( 152, 286),( 153, 286),( 154, 287),( 155, 287),( 156, 287),( 157, 288),( 158, 288),( 159, 288),( 160, 289),
( 161, 289),( 162, 290),( 163, 290),( 164, 291),( 165, 291),( 166, 292),( 167, 293),( 168, 293)

ECX RODS =111   ECX PTS = 168

NO. LO,MED, HI BURNUP ECX PTS =    17    66    82

NO. LO,MED,HI POWER ECX PTS =    22   108    38

NO.OLD AND NEW DESIGN ECX PT(BO,BN,PO,PN)=     0    58   110     0

NO.PTS.PER ECX SUBINTERVAL=    20    62    75     8     1     2

NO.LO,MED,HI BU PTS PER ECX SUBINTERVAL
   15     2     0     0     0     0
    1    23    37     1     1     1
    1    37    36     7     0     1

NO.LO,MED,HI POWER PTS PER ECX SUBINTERVAL
   12     5     1     1     1     2
    6    40    55     7     0     0
    2    17    19     0     0     0

NO.OLD AND NEW B&R AND P&R RODS PER ECX SUBINTERVAL
    0     0     0     0     0     0
   18    29     7     1     1     2
    2    33    68     7     0     0
    0     0     0     0     0     0

PT  RD    ECXSD          ABUSD          ALHRSD
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```
****************************************************  EFX  ****************************************************

(EFX ROD NO.EFX ROD ID)
( 001, 047),( 002, 050),( 003, 052),( 004, 053),( 005, 055),( 006, 057),( 007, 058),( 008, 061),( 009, 063),( 010, 065),
( 011, 058),( 012, 069),( 013, 070),( 014, 071),( 015, 072),( 016, 073),( 017, 074),( 018, 075),( 019, 076),( 020, 077),
( 021, 079),( 022, 079),( 023, 081),( 024, 084),( 025, 085),( 026, 086),( 027, 089),( 028, 091),( 029, 094),( 030, 095),
( 031, 096),( 032, 097),( 033, 098),( 034, 099),( 035, 101),( 036, 102),( 037, 103),( 038, 105),( 039, 106),( 040, 107),
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( 061, 188),( 062, 185),( 063, 190),( 064, 191),( 065, 192),( 066, 211),( 067, 213),( 068, 214),( 069, 220),( 070, 221),
( 071, 222),( 072, 223),( 073, 224),( 074, 225),( 075, 226),( 076, 227),( 077, 228),( 078, 229),( 079, 230),( 080, 231),
( 081, 232),( 082, 233),( 083, 234),( 084, 235),( 085, 236),( 086, 237),( 087, 238),( 088, 239),( 089, 240),( 090, 241),
( 091, 242),( 092, 243),( 093, 244),( 094, 245),( 095, 246),( 096, 247),( 097, 248),( 098, 249),( 099, 250),( 100, 251),
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(EFX PT. NO.EFX ROD ID)
( 001, 047),( 002, 050),( 003, 052),( 004, 053),( 005, 055),( 006, 057),( 007, 058),( 008, 061),( 009, 063),( 010, 065),
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( 021, 071),( 022, 072),( 023, 072),( 024, 072),( 025, 073),( 026, 073),( 027, 074),( 028, 074),( 029, 075),( 030, 076),
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( 071, 098),( 072, 098),( 073, 098),( 074, 098),( 075, 099),( 076, 099),( 077, 099),( 078, 099),( 079, 101),( 080, 101),
( 081, 101),( 082, 101),( 083, 102),( 084, 102),( 085, 102),( 086, 102),( 087, 103),( 088, 103),( 089, 103),( 090, 133),
( 091, 105),( 092, 105),( 093, 105),( 094, 105),( 095, 106),( 096, 106),( 097, 106),( 098, 106),( 099, 107),( 100, 107),
( 101, 137),( 102, 107),( 103, 110),( 104, 110),( 105, 110),( 106, 110),( 107, 111),( 108, 111),( 109, 111),( 110, 111),
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( 191, 260),( 192, 261),( 193, 262),( 194, 263),( 195, 264),( 196, 264),( 197, 265),( 198, 266),( 199, 266),( 200, 267),

( 201, 268),( 202, 269),( 203, 270),( 204, 270),( 205, 271),( 206, 272),( 207, 273),( 208, 274),( 209, 275),( 210, 276),
( 211, 277),( 212, 278)

EFX RODS =127   EFX PTS = 212

NO. LO,MED, HI BURNUP EFX PTS =    108    55    44

NO. LO,MED,HI POWER EFX PTS =    28   125    59

NO.OLD AND NEW DESIGN EFX PT(BO,BN,PO,PN)=    80    44    76    12

NO.PTS.PER EFX SUBINTERVAL=    2    16    89    70    33    2

NO.LO,MED,HI BU PTS PER EFX SUBINTERVAL
    0    11    52    35    10    0
    2     3    28    16     6    0
    0     2     9    14    12

NO.LO,MED,HI POWER PTS PER EFX SUBINTERVAL
    0     0     2    19     7    0
    0    15    76    29     5    0
    2     1    11    22    21    2
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************************************************** PIN ************************************************************

(PIN ROD NO,PIN ROD ID)
( 001, 032),( 002, 010),( 003, 011),( 004, 013),( 005, 014),( 006, 015),( 007, 021),( 008, 022),( 009, 029),( 010, 030),
( 011, 031),( 012, 032),( 013, 033),( 014, 035),( 015, 036),( 016, 037),( 017, 038),( 018, 084),( 019, 085),( 020, 086),
( 021, 087),( 022, 088),( 023, 089),( 024, 090),( 025, 091),( 026, 092),( 027, 093),( 028, 094),( 029, 095),( 030, 096),
( 031, 097),( 032, 098),( 033, 099),( 034, 100),( 035, 102),( 036, 103),( 037, 104),( 038, 105),( 039, 106),( 040, 107),
( 041, 108),( 042, 109),( 043, 110),( 044, 111),( 045, 112),( 046, 113),( 047, 114),( 048, 115),( 049, 142),( 050, 143),
( 051, 144),( 052, 145),( 053, 146),( 054, 147),( 055, 148),( 056, 169),( 057, 170),( 058, 171),( 059, 172),( 060, 257),
( 061, 258),( 062, 259),( 063, 260),( 064, 261),( 065, 262),( 066, 263),( 067, 264),( 068, 265),( 069, 266),( 070, 267),
( 071, 268),( 072, 270),( 073, 271),( 074, 272),( 075, 273),( 076, 274),( 077, 275),( 078, 276),( 079, 277),( 080, 278)

(PIN PT. NO,PIN ROD ID)
( 001, 002),( 002, 010),( 003, 011),( 004, 013),( 005, 014),( 006, 015),( 007, 021),( 008, 022),( 009, 029),( 010, 030),
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( 031, 097),( 032, 098),( 033, 099),( 034, 100),( 035, 102),( 036, 103),( 037, 104),( 038, 105),( 039, 106),( 040, 107),
( 041, 108),( 042, 109),( 043, 110),( 044, 111),( 045, 112),( 046, 113),( 047, 114),( 048, 115),( 049, 142),( 050, 143),
( 051, 144),( 052, 145),( 053, 146),( 054, 147),( 055, 148),( 056, 169),( 057, 170),( 058, 171),( 059, 172),( 060, 257),
( 061, 258),( 062, 259),( 063, 260),( 064, 261),( 065, 262),( 066, 263),( 067, 264),( 068, 265),( 069, 266),( 070, 267),
( 071, 268),( 072, 270),( 073, 271),( 074, 272),( 075, 273),( 076, 274),( 077, 275),( 078, 276),( 079, 277),( 080, 278)

PIN RODS = 80    PIN PTS = 80

NO. LO,MED, HI BURNUP PIN PTS =    13    46    21

NO. LO,MED,HI POWER PIN PTS =    10    49    21

NO.OLD AND NEW DESIGN PIN PT(BO,BN,PO,PN)=    29     2    49     0

NO.PTS.PER PIN SUBINTERVAL=    49     5     5     3     9     9

NO.LO,MED,HI BU PTS PER EFK SUBINTERVAL
     6     3     4     0     0     0
    22     2     1     3     9     9
    21     0     0     0     0     0

NO.LO,MED,HI POWER PTS PER PIN SUBINTERVAL
     5     2     3     0     0     0
    23     3     2     3     9     9
    21     0     0     0     0     0

NO.OLD AND NEW BWR AND PWR RODS PER PIN SUBINTERVAL
     6     1     1     3     7     9
     2     0     0     0     0     0
    41     4     4     0     0     0
     0     0     0     0     0     0

  PT   RD    PINZD            BUZD           MALHRZD

   1    2   .50227E-01      .33441E+05      .63830E+01
   2   10   .58205E-01      .33379E+05      .64202E+01
   3   11   .81924E+00      .18718E+05      .56600E+01
   4   13   .10861E+01      .21591E+05      .65765E+01
   5   14   .10475E+01      .18670E+05      .56543E+01
   6   15   .88811E+00      .25824E+05      .63563E+01
   7   21   .11614E+01      .29141E+05      .70936E+01
   8   22   .10930E+01      .25812E+05      .63877E+01
   9   29   .40654E+01      .18111E+05      .53791E+01
  10   30   .90634E+00      .16419E+05      .46861E+01
  11   31   .11507E+01      .18322E+05      .55226E+01
  12   32   .11458E+01      .17218E+05      .50312E+01
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16. ABSTRACT (200 words or less)

The second phase of acquisition, review, analysis, and processing of power reactor fuel performance data resources is described in this report. These data resources are characterized to support subsequent evaluations of the NRC-sponsored fuel rod behavior code, FRAPCON.

Application of the Fuel Performance Data Base is shown to provide the basic data files which are sorted, processed, and restructured to establish key parameters of interest on an individual rod basis. The design, operational, and performance parameters are analyzed to determine the data populations and the representation of various fuel design types in the data sample. Also presented are the performance data distribution and trends relative to operational parameters such as power and burnup, and a description of the data processing methods.

Significant amounts of power reactor fuel performance data are available to support high burnup code evaluation studies. The data clearly indicates the cumulative effects of rod deformation, fission gas release, and corrosion which tend to alter the as-built fuel rod thermal and mechanical conditions. The available data reflect the current status of commercial fuel utilization in that incumbent designs are gradually being replaced by high burnup designs, but the newer fuel types do not yet dominate the data sample.

17. KEY WORDS AND DOCUMENT ANALYSIS

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Data Acquisition Procedures
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