RIVER BEND UNIT 1

SAPHIRE 5.0
PROBABILISTIC RISK ASSESSMENT DATABASE
FOR INTERNALLY GENERATED EVENTS

IRRAS-LEVEL LOAD

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September 30, 1994

This database was developed in accordance with the requirements specified in the NRC's project for Plant Database Development for SAPHIRE (FIN W6241)

RIVER BEND UNIT 1
SAPHIRE 5.0 DATABASE
IRRAS-LEVEL LOAD
SEPTEMBER 30, 1994

FACT SHEET

WE CAN USE YOUR HELP

If problems, errors, or discrepancies are encountered when using this database, you are encouraged to call Mr. R. C. Robinson of the U. S. Nuclear Regulatory Commission's (NRC's) Office of Regulatory Research at (301) 492-3915, or R. D. Fowler or Dr. J. H. Bickel at the Idaho National Engineering Laboratory (INEL) at (208) 526-1257 and (208) 526-9622, respectively. We are interested in any feedback you can provide, whether positive or negative.

BACKUP THE ORIGINAL DATABASE

A backup copy of this database should be created and protected to prevent unintentional destruction or modification of the data and results initially loaded and generated.

THE SAPHIRE 5.0 CODES

Version 5.0 (officially released) of the SAPHIRE codes was used to develop this database. If any code related problems are encountered please contact Mr. Robinson or Mr. K. D. Russell at the INEL at (208) 526-9592.

THANK YOU FOR YOUR SUPPORT.

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1. INTRODUCTION

The data and information reported in Gulf States Utilities' (GSU's) River Bend Unit 1 individual plant examination (IPE) (Reference 1) for internally generated events were loaded into the Models and Results Database (MAR-D) system. This database was developed in support of the Nuclear Regulatory Commission's (NRC's) "Plant Database Development for SAPHIRE" project; FIN W6241 (Reference 2). The database was created using the Systems Analysis Programs for Hands-on Integrated Reliability Evaluations (SAPHIRE) Version 5.0 probabilistic risk assessment codes (Reference 3). This version of the SAPHIRE 5.0 codes has been officially released.

SAPHIRE is a suite of four programs that include (1) Models and Results Database (MAR-D) system, (2) Integrated Reliability and Risk Analysis System (IRRAS), (3) System Analysis and Risk Assessment (SARA) system, and (4) Fault Tree, Event Tree, and Piping and Instrumentation (FEP) Editors. These programs are briefly described in Section 2.

The River Bend plant SAPHIRE database is an IRRAS-level load. In an IRRAS-level load the accident sequence results are generated directly from the event tree and fault tree models included in the database. The data and information used to generate the database were taken from Reference 1, and additionally, from data provided directly by GSU in both hard-copy and electronic format. Event tree models were recreated as shown in the IPE, whereas the logic for the fault trees was extracted from GSU's electronic data. Direct support from GSU's PRA staff helped to ensure that this database is of the highest quality level achievable. The core damage frequency (CDF) calculated by IRRAS for the internally generated events is 1.582E-005/reactor year. This value is in reasonable agreement with the 1.55E-005/reactor year CDF reported in the IPE.

This letter report provides (1) an overview of the results reported in the River Bend IPE (Reference 1), (2) an overview of the database data, information, and results, (3) a discussion of the problems, discrepancies, or errors encountered in loading the data, (4) any data modifications or changes required to properly load the River Bend IPE data and information into the MAR-D system, and (5) any special requirements or procedures for using the database. It is not the intent of this report to provide detailed

procedures for developing the database, or for using the SAPHIRE codes.

This report includes:
- An introduction (Section 1).
- A brief outline of the SAPHIRE 5.0 codes (Section 2).
- An overview of the IPE-related information (Section 3).
- A comparison of the results reported in the IPE (Reference 1) with the results generated by IRRAS (Section 4).
- An overview of the results of the quality assurance verification and the internal independent review (Section 5).
- The details for any IPE related problems, discrepancies, or errors identified during the database development process (Section 6). Also, included in Section 6 are any special procedures used to load the PRA/IPE data into SAPHIRE.
- Any special guidance for using the database (Section 7).
- References (Section 8).

1.1 Purpose

The purpose of the NRC's Plant Database Development for SAPHIRE Program (FIN W6241) is to load PRA/IPE data and information into the MAR-D system to support the NRC's analytical needs. Such analytical needs may include additional safety studies, cost/benefit analysis, and an efficient means to evaluate generic safety issues (GSIs).

1.2 Objective

The objective of the NRC's Plant Database Development for SAPHIRE Program is to (1) provide databases containing PRA information from selected PRAs in a format suitable for NRC applications, and (2) to provide guidance and assistance to other programs, as necessary, regarding the use of this data.

The nuclear power plant PRA/IPE data and information were collected and loaded into SAPHIRE in accordance with the requirements specified in the Project and Budget Proposal for NRC Work (Reference 2). The requirements are designed to help ensure that PRA/IPE results are reasonably reproduced. It is not part of the project objective to review the PRA/IPEs for completeness, accuracy, or validity. However, the database development

process (by nature) does provide some checks; e.g., data received in an electronic format versus hard-copy data, data and information provided in the discussion versus the sequence and system results files, and undocumented data and information. Errors, discrepancies, or concerns identified during the development of the database were resolved (when possible) in close cooperation with GSU's PRA staff, knowledgeable engineering personnel familiar with the PRA/IPE process, and the NRC Project Manager (NRC PM). Those problems or concerns identified during the development of the database are found in Section 6 of this report.

1.3 Scope

The River Bend plant SAPHIRE 5.0 database is limited to that data, information, and results associated with internally generated events; i.e., externally generated events are not included. Also, verification and validation of the data, information, and results included in the database were dependent upon Reference 1 and support from GSU's PRA staff.

2. THE SAPHIRE CODES

The SAPHIRE 5.0 PRA codes are a suite of four individual programs. These programs are briefly described below. See references for details.

2.1 Integrated Reliability and Risk Analysis System (IRRAS)

The Integrated Reliability and Risk Analysis System (IRRAS) (Reference 4 and 5) is an integrated PRA-related software tool that provides the ability to create and analyze event trees, fault trees, and accident sequences using a microcomputer. This program provides functions that range from graphical event tree and fault tree construction to cut set generation and quantification.

2.2 Models and Results Database (MAR-D)

The Models and Results Database (MAR-D) system (Reference 6) is designed as a repository for the probabilistic risk assessment data and information. MAR-D also provides input and output routines in a format compatible with

other PRA tools (e.g., SARA, SETS, TEMAC, CAFTA, and NUPRA).

2.3 System Analysis and Risk Assessment (SARA)

The System Analysis and Risk Assessment (SARA) program (Reference 7 and 8) is used to interface with the data contained in MAR-D. SARA provides the capability to change data (e.g., basic event probabilities and uncertainty data, and initiating event frequencies) that resides in MAR-D, and then evaluate the effects of those changes through calculation of the resultant measures. The results can be displayed in both tabular and graphics format.

2.4 Fault Tree, Event Tree, and P&ID (FEP) Editors

The Fault Tree, Event Tree, and Piping and Instrumentation Diagram Editors (FEP) (Reference 9) provide the capability to create and edit graphics that can be used by the IRRAS or MAR-D 5.0 programs. Although the FEP program does provide access to the graphics in MAR-D no analytical capabilities are involved.

3. PROBABILISTIC RISK ASSESSMENT DATA AND INFORMATION

3.1 River Bend Unit 1 Background Information

River Bend is operated by the Gulf States Utilities Company (GSU). The plant is located approximately 24 miles NNW of Baton Rouge, LA. It is a General Electric BWR-Mark 3 plant with a net capacity of 2894 MWt. River Bend began commercial power generation in June 1986.

3.2 Overview of the PRA Results

The River Bend Unit 1 PRA/IPE was developed by a project team under the direction of GSU. Project team members consisted of several engineers from GSU, Halliburton-NUS, Reliability and Performance Associates (RAPA), and Science Applications International Corporation (SAIC). The PRA/IPE consists of both the Level 1 and Level 2 analyses. The IPE was developed using the small event tree/large linked fault tree approach. CAFTA, a PRA software code, was the primary tool used to develop the PRA. The CDF point estimate

reported in the River Bend IPE is 1.55E-005 per reactor year (mean value of 1.87E-005). A brief summary of the IPE data, information, and results for the internal events analysis is presented in the following sections.

3.2.1 Fault Tree Development

The following 24 River Bend plant systems were evaluated in the PRA/IPE.

- High Pressure Core Spray System (HPCS)
- Reactor Core Isolation Cooling System (RCIC)
- Automatic Depressurization System (ADS)
- Low Pressure Core Spray System (LPCS)
- Low Pressure Coolant Injection System (LPCI)
- Suppression Pool Cooling (SPC)
- Shutdown Cooling (RHR)
- Reactor Protection System (RPS)
- Standby Liquid Control System (SLCS)
- Containment Isolation System (CIS)
- Electric Power System (EPS)
- Engineering Safety Feature Actuation System (ESFAS)
- Standby Service Water (SSW)
- Normal Service Water Turbine Plant Component Cooling Water (TCCPW)/Service Water Cooling
- Reactor Plant Component Cooling Water (RPCCW)
- Plant Air System (PAS)
- Containment Venting System (CVS)
- Heating, Ventilation, and Air Conditioning (HVAC)
- Power Conversion System (PCS)
- Control Rod Drive (CRD)
- Recirculation Pump Trip (RPT)
- Fire Protection Water (FPW)
- Containment Fan System (CFS)
- Combustible Gas Control System (HCS)

3.2.2 Event Tree Development, Quantification, and CDF Profile

The initiating events, the event tree descriptions, and the associated frequencies used in the River Bend IPE are listed in Table 3.2.2-1.

Table 3.2.2-1. River Bend Initiating Events and Related Frequencies.

Initiating Event Name	Description	Mean Frequency per Year
A	LARGE LOCA	1.00E-004
S1	INTERMEDIATE LOCA	3.00E-004
S2	SMALL LOCA	1.00E-003
S3	SMALL-SMALL LOCA (Recirc. Pump Seal LOCA)	2.00E-002
T1	LOSS OF OFFSITE POWER TRANSIENT	3.50E-002
T2	TRANSIENT WITH LOSS OF PCS	1.66E+000
T3A	TRANSIENT WITH PCS AVAILABLE	2.00E+000
T3B	LOSS OF FEEDWATER TRANSIENT	7.60E-001
T3C	INADVERTENT SRV OPENING TRANSIENT	1.40E-001
TB	STATION BLACKOUT - Not a separate initiator but a sequence of concern that could result from other initiators.	
TDCI	LOSS OF dc DIVISION I TRANSIENT	6.00E-003
TDCII	LOSS OF dc DIVISION II TRANSIENT	6.00E-003

Table 3.2.2-1. River Bend Initiating Events and Related Frequencies. (Continued)

Initiating Event Name	Description	Mean Frequency per Year
TNSW	LOSS OF NORMAL SERVICE WATER TRANSIENT	7.60E-003
TCCS	LOSS OF TURBINE PLANT COMPONENT COOLING WATER TRANSIENT	2.00E-003
TCCP	LOSS OF REACTOR PLANT COMPONENT COOLING WATER TRANSIENT	2.00E-003
TIAS	LOSS OF INSTRUMENT AIR TRANSIENT	1.20E-004
TMST	LOSS OF MAIN STEAM TUNNEL COOL TRANSIENT	5.00E-002
V	INTERFACING SYSTEMS LOCA	4.00E-003
ATWS	ANTICIPATED TRANSIENT WITHOUT SCRAM - Not a separate initiator but a sequence of concern that could result from other initiators.	

The CDF profile reported in the IPE for the River Bend plant accident sequence initiators is provided in Table 3.2.2-2.

Table 3.2.2-2. River Bend Core Damage Frequency Profile by Initiator.

Initiator	Description	Frequency/year
T1	Loss of Offsite Power	1.4E-005
TNSW	Loss of Normal Service Water	7.5E-007
T3B	Loss of Feedwater	3.7E-007
TCCP	Loss of Reactor Plant Component Cooling	2.8E-007
T3A	Transient with PCS Available	5.6E-008
T2	Transient with Loss of PCS	4.6E-008
	TOTAL CDF =	1.55E-005

The CDF profile reported in the IPE for the River Bend plant accident sequences by accident types is provided in Table 3.2.2-3.

Table 3.2.2-3. River Bend Core Damage Frequency by Accident Type.

Accident Type	Frequency
Station Blackout	1.3E-005
Transient	1.3E-006
Loss of Offsite Power	6.7E-007
Transient Induced LOCA	2.4E-007

3.2.3 Plant Damage State Profile

The plant damage/end state data and results included in the River Bend SAPHIRE 5.0 database are for information only.

4. MAR-D DATABASE INFORMATION

4.1 Overview of the MAR-D Database Information

The River Bend Unit 1 SAPHIRE 5.0 database was developed from data and information extracted from the IPE, and from PRA-related hard-copy and electronic data files provided by GSU. These files were converted into the required format and loaded into the MAR-D system. Event tree models were manually created and loaded into SAPHIRE as shown in the IPE. The fault tree models were also developed from logic files provided by GSU. The CDF results in the database were generated using the event tree and fault tree logic. A comparison of the River Bend IPE dominant accident sequence results and the IRRAS results is provided in Table 4.2-1.

4.2 Accident Sequence Data

As stated previously, the accident sequence data and information reported in the River Bend plant IPE have been loaded into the SAPHIRE IRRAS-level database. The CDF generated using IRRAS is 1.582E-005/reactor year, which is in very good agreement with the 1.55E-005 point estimate CDF reported in the IPE. This reproducibility is, in a large part, due to the assistance provided by GSU's PRA staff. A comparison of the IPE and SAPHIRE accident sequence results is provided in Table 4.2-1. Because little information is available for other than the dominant accident sequences, only the dominant accident sequence results can be verified and validated. Thus, the user should use care when generating nondominant accident sequence results.

Table 4.2-1. Comparison of the Accident Sequence Results - IPE vs. IRRAS.

Event Tree	IPE Seq. Name/ IRRAS Name	IPE Func. Name	IPE MinCut	IRRAS MinCut	No. of IRRAS Cutsets	Comments, if any
T1	T1-1 1-52-11	T1UXLT	9.82E-009	9.825E-009	4	SEE NOTE 1
T1	T1-20 1-52-16	T1W	2.89E-009	2.891E-009	2	
T1	T1-24 1-52-20	T1W	2.89E-009	2.891E-009	2	
T1	T1-S117 1-50-17	S1UX	4.88E-009	1.091E-008	3	SEE NOTE 2
T1	T1-S228 1-52-28-28	S2QUX	3.16E-009	3.161E-009	2	
T1	T1-S229 1-52-28-29	S2UX	8.56E-009	9.690E-009	5	SEE NOTE 2
T1	T1-T129 1-52-25	T1UV	1.08E-007	1.075E-007	40	
T1	T1-T130 1-52-26	T1UX	5.40E-007	5.424E-007	58	
T1	T1-TB3 1-53-03	TBU	8.31E-006	8.308E-006	887	
T1	T1-TB4 1-53-04	TBUX	4.58E-006	5.521E-006	354	

Table 4.2-1. Comparison of the Accident Sequence Results - IPE vs. IRRAS. (Continued)

Event Tree	IPE Seq. Name/ IRRAS Name	IPE Func. Name	IPE MinCut	IRRAS MinCut	No. of IRRAS Cutsets	Comments, if any
T1	T1-TB6 1-53-06	TBU	2.84E-007	3.128E-007	29	SEE NOTE 2
T1	T1-TB9 1-53-09	TBU	3.32E-007	3.345E-007	64	
T1	T1-TB10 1-53-10	TBUX	8.58E-008	1.007E-007	19	SEE NOTE 3
T2	T2-S117 1-50-17	S1UX	2.63E-009	2.629E-009	1	
T2	T2-S224 1-51-24	S2W	1.10E-009	1.098E-009	1	
T2	T2-S229 1-51-29	S2UX	1.85E-008	1.855E-008	8	SEE NOTE 4
T2	T2-T44 1-39	TW	1.21E-009	1.210E-009	1	
T2	T2-T54 1-49	TQUX	4.80E-009	4.802E-009	3	
T2	T2L-TB3 1-53-03	TBU	9.94E-009	9.941E-009	6	

Table 4.2-1. Comparison of the Accident Sequence Results - IPE vs. IRRAS. (Continued)

Event Tree	IPE Seq. Name/ IRRAS Name	IPE Func. Name	IPE MinCut	IRRAS MinCut	No. of IRRAS Cutsets	Comments, if any
T2	T2L-TB4 1-53-04	TBUX	6.91E-009	6.907E-009	3	
T3A	T3A-S117 1-50-17	S1UX	3.17E-009	3.168E-009	1	
T3A	T3A-S224 1-51-24	S2W	1.32E-009	1.323E-009	1	
T3A	T3A-S229 1-51-29	S2UX	2.31E-008	2.235E-008	8	SEE NOTE 5
T3A	T3A-T44 1-39	TW	1.46E-009	1.458E-009	1	
T3A	T3A-T54 1-49	TQUX	5.79E-009	7.907E-009	3	SEE NOTE 2
T3A	T3AL-TB3 1-53-03	TBU	1.31E-008	1.305E-008	7	
T3A	T3AL-TB4 1-53-04	TBUX	8.32E-009	8.322E-009	3	
T3B	T3B-S117 1-50-17	S1UX	1.20E-009	1.203E-009	1	

Table 4.2-1. Comparison of the Accident Sequence Results - IPE vs. IRRAS. (Continued)

Event Tree	IPE Seq. Name/ IRRAS Name	IPE Func. Name	IPE MinCut	IRRAS MinCut	No. of IRRAS Cutsets	Comments, if any
T3B	T3B-S214 1-51-14	S2UXLT	4.38E-009	6.437E-009	3	SEE NOTE 2
T3B	T3B-S228 1-51-28	S2QUV	1.14E-008	1.157E-008	4	
T3B	T3B-S229 1-51-29	S2UX	1.52E-007	1.482E-007	31	
T3B	T3B-T50 1-45	TQUV	1.84E-007	1.837E-007	46	
T3B	T3B-T54 1-49	TQUX	1.59E-008	1.595E-008	10	SEE NOTE 6
T3B	T3BL-TB3 1-53-03	TBU	1.26E-009	1.261E-009	1	
T3B	T3BL-TB4 1-53-04	TBUX	1.56E-009	1.561E-009	1	
TCCP	CCP-S229 1-51-29	S2UX	1.40E-009	1.404E-009	1	
TCCP	CCP-T44 1-39	TW	1.50E-007	1.503E-007	38	
TCCP	CCP-T54 1-49	TQUX	1.33E-007	1.329E-007	31	

Table 4.2-1. Comparison of the Accident Sequence Results - IPE vs. IRRAS. (Continued)

Event Tree	IPE Seq. Name/ IRRAS Name	IPE Func. Name	IPE MinCut	IRRAS MinCut	No. of IRRAS Cutsets	Comments, if any
TNSW	NSW-S229 1-51-29	S2UX	9.62E-009	9.623E-009	3	
TNSW	NSW-T49 1-44	----	---------	5.769E-008	10	SEE NOTE 7
TNSW	NSW-T50 1-45	TQUV	1.00E-007	1.002E-007	22	
TNSW	NSW-T54 1-49	TQUX	6.388E-007	6.408E-007	104	
TOTALS			1.55E-005	1.582E-005	1843	

NOTES:

1. The frequency listed in IPE Table 3.4-22 for this sequence is 9.66E-009. The final "Cutset Report" data received from GSU correctly reports the frequency as 9.82E-009.
2. IRRAS generates extra cutsets for this sequence. GSU confirmed the IRRAS results are valid.
3. Sequence T1-TB10 is reported in the IPE as a dominant accident sequence. Based on information provided by the River Bend plant PRA staff, this sequence should not have been listed as a dominant accident sequence as the frequency was subsequently calculated to be below the 1.0E-009 cutoff level. The sequence frequency (8.58E-008) was not factored into the 1.55E-005/reactor year CDF
4. The frequency listed in IPE Table 3.4-22 for this sequence is 1.92E-008. The final "Cutset Report" data received from GSU correctly reports the frequency as 1.85E-008.

5. The IPE includes extra cutsets. Based on information provided by GSU these cutsets should have been eliminated. The IRRAS results were confirmed as valid.
6. The frequency listed in IPE Table 3.4-22 for this sequence is 1.49E-008. Per GSU, the final "Cutset Report" data (transmitted separate to the IPE data) correctly reports the frequency as 1.59E-008.
7. GSU combined this sequence with another sequence (or sequences). Except one cutset, the IRRAS results were confirmed as valid. The exception involved an extra cutset that included basic event CSH-HEEHFR-F015. Based on this basic event, the cutset was eliminated during the initial screening process. To compensate for this in IRRAS, the cutset was eliminated by assigning a recovery factor to the cutset: HEEHFR015-SCREEN with a screening value of 1.67E-001 (provided by GSU).

A report of all sequences, sequence cutsets, and related data can be viewed within (or extracted from) the database using either the IRRAS or SARA display or report features.

5. DATABASE QUALITY CONTROL

5.1 Internal Quality Assurance Checks

Internal quality assurance (QA) checks of the individual MAR-D database files (called "flat files") were made to ensure that all data loaded into the database is complete and accurate. The IRRAS quantified results for the dominant accident sequences were checked against the results reported in the River Bend IPE. Although nondominant accident sequences can be successfully generated, there are no IPE data available with which to compare the results. Thus, the user should use caution when generating nondominant sequences. For example, it will be necessary to identify and assign recovery rules appropriately.

5.2 Independent Review

An internal independent review of the River Bend plant SAPHIRE 5.0 IRRAS-level database was done (Reference 10). The review included checks of

textual information, event tree and fault tree logic, basic event data, sequence and sequence cutset generation and results, and reports generation. All problems identified were resolved.

6. PRA-RELATED DATA PROBLEMS AND REQUIRED MODIFICATIONS

This section discusses those problems and discrepancies identified during the development of the River Bend Unit 1 SAPHIRE 5.0 IRRAS-level database. Also, any modifications required to load the plant PRA/IPE data into SAPHIRE are discussed.

6.1 Event Tree Data

The event tree models reported in the IPE were reproduced and loaded into the River Bend database. The event trees models were verified for proper generation of sequences and sequence cutsets. Some top events were duplicated in the IPE models, but for different scenarios. This condition is not allowed when using IRRAS. In IRRAS, the redundant top event were each assigned unique identities.

The following event tree top events and applicable comments listed in Table 6.1-1 are not included in the IPE. The data were provided separately by GSU.

Table 6.1-1. Special Handling of Specific Event Tree Top Events.

Top Event Name	Comments
C	ATWS top event. For use in all but the Transient and LOSP event trees; ATWS is not quantified because it falls below the truncation level.
L	Probability of isolating the recirculation pump seal LOCA. The probability of not isolating this break is less than 5.0E-002. Therefore, the S3 sequence is bounded by the S2 sequence. Since no S2 cutsets survived initial quantification the small-small LOCA event tree was not quantified. No point estimate is included for this event because the event is not required for quantification.
SCRM	Represents the probability of a manual scram. This probability is captured in the other ATWS fault trees. Note: the point estimates for RPSM, RPSE, ARI, and MRI were replaced by fault trees in the IPE model. See the ATWS fault tree for the actual top gates.
NOADS	Represents a failure of the operator to inhibit automatic depressurization during an ATWS. Since the frequency for the combination of an ATWS and this explicit EOP action is below the truncation level used, this event is screened from the analysis.
CST	This event is replaced with CSH-HEEHFR-CSTRL for quantification. See the ATWS event tree.
RUPTURE	This is a V sequence event, which is handled qualitatively by the IPE. Therefore, this event is not included in the database.
SIZE	Same comment as for RUPTURE.

Table 6.1-1. Special Handling for Specific Event Tree Top Events. (Continued)

Top Event Name	Comments
ISOLATE	Same comment as for RUPTURE.
X3	This event is the same as X2.
SMALL	Same comment as for RUPTURE.

The transient event tree is not used for the T1 initiator. The T1 initiating event starts with the LOSP tree. T1 concurrent with an ATWS is handled through the ATWS tree. The LOSP tree is not transferred to because it was not developed to handle an ATWS case.

The S3 event tree is not explicitly quantified in the IPE. Based upon the IPE, the S3 initiator (1) replaces S2 in any S2 cutsets that survived truncation (however, none did) or (2) is added to any of the transient sequences that did not have an initiating event and had a cutset probability above 5.0E-008 after recoveries and human actions are applied.

6.2 Fault Tree Data

Fault tree logic files were received as electronic files from GSU. The logic files were downloaded and formatted for loading into MAR-D. The resultant models were verified for proper generation of system cutsets. After the initial loading of the fault tree models into MAR-D, the models were paginated to provide smaller models for viewing convenience. This resulted in having to rename several top gate names (system top events or top gates of transfer trees). Table A-1 in Appendix A provides a cross-reference of those gates involved.

6.3 Sequence Data

The IRRAS generated CDF is in reasonable agreement with the IPE. However, differences in individual sequences are noted in Table 4.2-1 of Section 4. Even so, the IRRAS results reasonably reproduce the IPE results.

Results are reported in the PRA/IPE for dominant accident sequences only. Thus, it is the dominant accident sequences and sequence cutset results retained in the River Bend SAPHIRE 5.0 database. Although the nondominant accident sequences can be generated and quantified, no results are available in the IPE for comparison. Another significant problem with the nondominant accident sequences involves the application of recovery and human error events. Typically the PRAs/IPEs do not provide the needed details for applying these events to the nondominant sequences. Because of this, all nondominant sequences have been set to "ignore."; i.e., an "@" symbol (see Reference 3) has been added as a prefix to all but the dominant accident sequences. To generate and quantify sequences marked with an "@" symbol, the "@" symbol must first be removed.

As noted in Table 4.2, sequence T1-TB10 is reported in the IPE as a dominant accident sequence. However, based on information provided by the River Bend plant PRA staff, this sequence should not have been listed as a dominant accident sequence. In subsequent analyses, the calculated frequency for T1-TB10 fell below the 1.0E-009 cutoff level. Because information was not learned to provide the exact criteria used to reduce the frequency, it was not eliminated from the IRRAS results. The overall effect on the core damage frequency is negligible.

6.4 Basic Event Data

The basic event data were loaded into SAPHIRE from electronic files provided by GSU. Basic event related discrepancies, or changes made to the basic events included in the database, are identified in table 6.4-1.

Table 6.4-1. River Bend Basic Event Discrepancies and IRRAS Changes.

Basic Event Name	Problem or Discrepancy
T1	T1 is an initiating event. The frequency reported in the IPE is 3.50E-002, whereas the frequency listed in the electronic data received from GSU is 1.00E-001. Because the 3.50E-002 best duplicates the T1 sequence results, this value is loaded into the database.
ORA-OSP2.5HRS	The IPE involves basic events that include "decimal points" in the names. This is not allowed in the SAPHIRE codes. Such events were modified; e.g., ORA-OSP150MINS.
P	The frequency reported in the IPE for this sequence is 2.0E-003, however, the frequency received in the CAFTA BEFILE.RPT file lists a value of 1.00E-003. Based on information from GSU, 1.00E-003 is used in the database.
HEEHFR015-SCREEN	This event was added to the database as a screening value to eliminate a cutset from sequence NSW-1-44 (IPE sequence NSW-T49).
ICS-HEEHFRLVCTL	The probability listed for this human action was reported in the CAFTA BEFILE.RPT as 1.0. Per GSU it should have been 1.0E-001.
HEE-SCREENVALUE	For some sequences, the IRRAS generated cutsets included more than two human errors. In coordination with GSU's PRA staff, this screening event was added to the cutsets through use of the IRRAS recovery rule feature. The value assigned to this event is 1.0E-002.

6.5 Uncertainty Data

Because an uncertainty analysis was not done for the River Bend plant, no uncertainty data are reported in the IPE. However, the basic events were correlated, and an uncertainty analysis was done using IRRAS. The uncertainty analysis results are reasonable, but there are no data in the IPE with which to compare.

6.6 Sequence Recovery

Several sequence recovery rules were created in IRRAS for use with the dominant accident sequences. Rather than define the rules here, it is recommended that, if needed, the rules can be extracted from the database via the Utility command (See Reference 4 for details).

The recovery rules listed in the IPE are associated with the dominant accident sequences. Thus, the rules developed in IRRAS are for use with these same sequences. Recovery events were applied as implied by the IPE. However, it was found that the IPE rules were not applied consistently. This resulted in the need to verify the sequence results with the River Bend PRA staff. Without their help, resolution of the problems would have been very difficult to impossible. No recovery rules are developed in the PRA/IPE for the nondominant accident sequences, thus, none are included in the SAPHIRE database.

6.7 Mutually Exclusive Events

Those sequences that include combinations of events (or conditions) that would result in "Technical Specification" violations were eliminated from all sequences through use of the IRRAS "Recover Cutsets" feature. This was done by creating mutually exclusive event rules which are applied at the "Family" level (see Reference 4 for details). These rules can also be extracted from the database through use of the SAPHIRE code Utility feature.

6.8 Sequence End States

The end states for the dominant accident sequences were manually assigned using the IRRAS "Modify Sequences" option (see Reference 4).

6.9 Sequence Flag Sets

Several "Flag Sets" were used in the SAPHIRE 5.0 database for handling specific conditions identified in the IPE for some events or fault tree gates. These "Flag Sets" are included in the IRRAS "Change Sets" feature, however, they should NOT be marked (as is required for a "Change Set") for use. The "Flag Sets" are automatically applied when generating sequences. These "Flag Sets" and the related data, can either be viewed within the database or can be extracted from the database using the IRRAS "Utilities" option in the "Main Menu."

6.10 Piping and Instrumentation Diagrams

No piping and instrumentation diagrams (P&IDs) are included in this database.

7. DATABASE APPLICATION

7.1 Overview

Following is a brief outline of the SAPHIRE database, the data and information related problems or concerns, and any special procedures required to use this database. It is not intended that detailed instructions be provided for developing the database. Additionally, it is not intended that the procedures and instructions provided for the SAPHIRE codes (References 3 through 9) be repeated herein.

The letter report is included within the River Bend database under the "FAMILY" "TEXT" information. The letter report can be viewed either on the PC screen or routed to a printer using the "REPORT" option in IRRAS or SARA (see References 4 and 7, respectively). Additionally, the letter report is also included in the database directory as a "README.DOC" file (ASCII format).

The River Bend database is an IRRAS-level load; i.e., the plant dominant accident sequences and sequence cutsets are reproduced using the event tree and fault tree logic. All data needed to develop the database were

extracted from either the IPE or hard-copy and/or electronic data provided by GSU.

The event tree models were created and loaded into SAPHIRE as shown in the IPE. The only significant modifications made to the models were those required to ensure that the event tree top events were unique. If deemed appropriate, some models were paginated in smaller segments to enhance viewing on the PC screen. All models have been successfully linked and verified to ensure reasonable generation of sequences. Data and information are principally available in the IPE for only the dominant accident sequences, thus, only these sequences were retained in the River Bend database. No problems are expected if the nondominant accident sequences are generated, however, the user is responsible for developing and applying recovery and human error events to the sequences.

The fault tree models loaded into MAR-D were created using logic files provided by GSU as electronic files. The fault tree models were also linked and verified for successful generation of system cutsets.

Using IRRAS, the dominant accident sequences and sequence cutsets were generated and quantified. Sequence "Flag Sets" were developed for specific sequences and are automatically applied when the sequences are generated. Section 6.7 provides more information on the "Flag Sets". Table 4.2-1 in Section 4 provides a comparison of the results with the IPE. Also, GSU was consulted for resolution of outstanding concerns; e.g., inconsistencies or discrepancies identified in the PRA/IPE data. A significant inconsistency involved the definition for the application of recovery events to sequence cutsets (see Section 6.5). This inconsistency is typical of those found in other PRAs/IPEs. Because data and information are principally available for only the dominant accident sequences, the user is responsible for verification of the nondominant results. Also, the user is responsible for deciding the recovery rules that may need to be applied. This may require the support of the GSU PRA staff.

Also, the PRAs/IPEs typically do not provide the needed details to fully develop the nondominant accident sequences. Because of this, the related event tree branches have been set to "ignore (process flag is set to 'I')." This is done by inserting an "@" symbol (see Reference 3) as a prefix to the

"End State" name. If the user needs to generate the nondominant accident sequences, the "@" symbol must first be removed (see Reference 4 for details). Again, generation of the nondominant sequences requires the user to create and apply all needed recovery or human error events.

8.0 REFERENCES

1. Gulf States Utilities, "River Bend Station Individual Plant Examination," EA-RA-93-0001-M, January 15, 1993.

2. NRC Form 189, "Plant Database Development for SAPHIRE," Task 2.1, "Add the River Bend Unit 1 Plant into MAR-D 5.0," FIN W6241, August 1994.

3. K. D. Russell et al., "Systems Analysis Programs for Hands-on Integrated Reliability Evaluations (SAPHIRE) Version 5.0, Technical Reference Manual," NUREG/CR-6116 (EGG-2716), Volume 1, July 1994.

4. K. D. Russell et al., "Systems Analysis Programs for Hands-on Integrated Reliability Evaluations (SAPHIRE) Version 5.0, Integrated Reliability and Risk Analysis System (IRRAS), Reference Manual," NUREG/CR-6116 (EGG-2716), Volume 2, July 1994.

5. K. D. Russell et al., "Systems Analysis Programs for Hands-on Integrated Reliability Evaluations (SAPHIRE) Version 5.0, Integrated Reliability and Risk Analysis System (IRRAS) Tutorial Manual," NUREG/CR-6116 (EGG-2716), Volume 3, July 1994.

6. K. D. Russell, N. L. Skinner, "Systems Analysis Programs for Hands-on Integrated Reliability Evaluations (SAPHIRE) Version 5.0, Models and Results Database (MAR-D) Tutorial Manual," NUREG/CR-6116 (EGG-2716), Volume 8, July 1994.

7. K. D. Russell et al., "Systems Analysis Programs for Hands-on Integrated Reliability Evaluations (SAPHIRE) Version 5.0, Systems Analysis and Risk Assessment (SARA) Reference Manual," NUREG/CR-6116 (EGG-2716), Volume 4, July 1994.

8. K. D. Russell et al., "Systems Analysis Programs for Hands-on Integrated Reliability Evaluations (SAPHIRE) Version 5.0, Systems Analysis and Risk Assessment (SARA) Tutorial Manual," NUREG/CR-6116 (EGG-2716), Volume 5, July 1994.

9. M. K. McKay et al., "Systems Analysis Programs for Hands-on Integrated Reliability Evaluations (SAPHIRE) Version 5.0, Fault Tree, Event Tree, and Piping and Instrumentation Diagram (FEP) Editors Reference Manual," NUREG/CR-6116 (EGG-2716), Volume 7, July 1994.

10. R. Gregg (G. D. Barri & Associates) letter to R. D. Fowler, "Review of the River Bend Unit 1 SAPHIRE 5.0 Database," August 10, 1994.

APPENDIX A. IRRAS Fault Tree Gate Modifications

In loading the fault tree models into MAR-D, the fault trees were "paginated" (reduced to several small files) to allow more convenient viewing on the PC screen. Each small file must be uniquely identified, and the file names must not exceed eight characters (DOS limitation). This necessitated renaming many fault tree gate names (top gate names equal the corresponding file name). The fault tree gates that were modified for use in the SAPHIRE 5.0 database are tabulated in Table A-1.

Also, listed in the table are fault tree gate names found in the database but not in the PRA/IPE. Most of these gates represent the PRA/IPE event tree top event names; IRRAS handles these as if they are small fault trees.

Table A-1. River Bend Fault Tree Gate Name Changes - PRA/IPE versus IRRAS.

PRA/IPE Gate Name	IRRAS Gate Name	Gate Description
	ARI	ROD INSERTION
	B	OFFSITE POWER DIV I OR DIV II
	C	REACTOR PROTECTION
	CST	SWITCH HPCS PUMP SUCTION BACK TO CST
EPS001-BYS	EPS001-B	LOSS OF DIVISION A AC POWER. (AT 4160KV BUS 1ENS*SWG1A)
EPS001-CSH	EPS001-C	LOSS OF DIVISION A AC POWER. (AT 4160KV BUS 1ENS*SWG1A)
EPS001-FLS	EPS001-F	LOSS OF DIVISION A AC POWER. (AT 4160KV BUS 1ENS*SWG1A)
EPS001-HVX	EPS001-H	LOSS OF DIVISION A AC POWER. (AT 4160KV BUS 1ENS*SWG1A)
EPS002-FLS	EPS002-F	LOSS OF AC POWER DIV A DUE TO LOSS OF STBY SWGR A RM VENT

Table A-1. River Bend Fault Tree Gate Name Changes - PRA/IPE versus IRRAS. (Continued)

PRA/IPE Gate Name	IRRAS Gate Name	Gate Description
EPS003-FLS	EPS003-F	LOSS OF AC POWER TO DIVISION A BUSES. (4160KV 1ENS*SWG1A)
EPS003-HVX	EPS003-H	LOSS OF AC POWER TO DIVISION A BUSES. (4160KV 1ENS*SWG1A)
EPS004-FLS	EPS004-F	LOSS OF PWR TO DIV A AC BUSES.(4160KV 1ENS*SWG1A)
EPS004-HVX	EPS004-H	LOSS OF PWR TO DIV A AC BUSES (1ENS*SWG1A)
EPS011-BYS	EPS011-B	LOSS OF DIVISION B AC POWER. (AT 4160KV BUS 1ENS*SWG1B)
EPS011-CSH	EPS011-C	LOSS OF DIVISION B AC POWER. (AT 4160KV BUS 1ENS*SWG1B)
EPS011-FLS	EPS011-F	LOSS OF DIVISION B AC POWER. (AT 4160KV BUS 1ENS*SWG1B)
EPS011-SSW	EPS011-S	LOSS OF DIVISION B AC POWER. (AT 4160KV BUS 1ENS*SWG1B)
EPS012-FLS	EPS012-F	LOSS OF AC PWR DIV B DUE TO LOSS OF STBY SWGR RM B VENT
EPS013-FLS	EPS013-F	LOSS OF AC PWR TO DIV B BUSES. (4160KV BUS 1ENS*SWG1B)
EPS013-SSW	EPS013-S	LOSS OF AC PWR TO DIV B BUSES. (4160KV BUS 1ENS*SWG1B)
EPS014-FLS	EPS014-F	LOSS OF AC PWR TO DIV B BUSES (4160KV 1ENS*SWG1B)
EPS014-SSW	EPS014-S	LOSS OF AC PWR TO DIV B BUSES (4160KV 1ENS*SWG1B)
EPS021-FLS	EPS021-F	LOSS OF DIVISION C AC POWER. (AT 4160KV BUS 1E22*S004)
EPS021-HVX	EPS021-H	LOSS OF DIVISION C AC POWER. (AT 4160KV BUS 1E22*S004)

Table A-1. River Bend Fault Tree Gate Name Changes - PRA/IPE versus IRRAS. (Continued)

PRA/IPE Gate Name	IRRAS Gate Name	Gate Description
EPS022-FLS	EPS022-F	LOSS OF AC PWR DIV C DUE TO LOSS OF STBY SWGR ROOM B VENT
EPS023-FLS	EPS023-F	LOSS OF AC POWER TO DIV C BUSES. (4160KV BUS 1E22*S004)
EPS023-HVX	EPS023-H	LOSS OF AC POWER TO DIV C BUSES. (4160KV BUS 1E22*S004)
EPS024-FLS	EPS024-F	LOSS OF AC PWR TO DIV C BUSES (4160 BUS 1E22*S004)
EPS024-HVX	EPS024-H	LOSS OF AC PWR TO DIV C BUSES (4160 BUS 1E22*S004)
EPS031-DG	EPS031-D	LOSS OF DIVISION A DC POWER. (AT DC BUS 1ENB*SWG01A)
EPS031-FLS	EPS031-F	LOSS OF DIVISION A DC POWER. (AT DC BUS 1ENB*SWG01A)
EPS031-HVX	EPS031-H	LOSS OF DIVISION A DC POWER. (AT DC BUS 1ENB*SWG01A)
EPS032-FLS	EPS032-F	LOSS OF DC POWER FROM BOTH THE CHARGER AND THE BATTERRY
EPS032-HVX	EPS032-H	LOSS OF DC POWER FROM BOTH THE CHARGER AND THE BATTERRY
EPS032A-FLS	EPS032AF	NO AC PAWER TO OR FAIL OF CHGR 1ENB*CHGR01A
EPS034-DG	EPS034-D	LOSS OF DC PWR
EPS034-FLS	EPS034-F	LOSS OF DC PWR
EPS041-DG	EPS041-D	LOSS OF DIVISION B DC POWER. (AT DC BUS 1ENB*SWG01B)
EPS041-FLS	EPS041-F	LOSS OF DIVISION B DC POWER. (AT DC BUS 1ENB*SWG01B)
EPS041-HVX	EPS041-H	LOSS OF DIVISION B DC POWER. (AT DC BUS 1ENB*SWG01B)

Table A-1. River Bend Fault Tree Gate Name Changes - PRA/IPE versus IRRAS. (Continued)

PRA/IPE Gate Name	IRRAS Gate Name	Gate Description
EPS042-FLS	EPS042-F	LOSS OF DC POWER FROM BOTH THE CHARGER AND THE BATTERY
EPS042-HVX	EPS042-H	LOSS OF DC POWER FROM BOTH THE CHARGER AND THE BATTERY
EPS042A-FLS	EPS042AF	NO AC POWER TO OF CHGR 1ENB*CHGR01B FAILS
EPS044-DG	EPS044-D	LOSS OF DC PWR
EPS044-FLS	EPS044-F	LOSS OF DC PWR
EPS051-DG	EPS051-D	LOSS OF 125V DC POWER DIVISION C. (AT STBY BUS 1E22*S001)
EPS051-FLS	EPS051-F	LOSS OF 125V DC POWER DIVISION C. (AT STBY BUS 1E22*S001)
EPS051-HVX	EPS051-H	LOSS OF 125V DC POWER DIVISION C. (AT STBY BUS 1E22*S001)
EPS052-DG	EPS052-D	LOSS OF DC POWER FROM BOTH THE CHARGER AND THE BATTERY
EPS052-FLS	EPS052-F	LOSS OF DC POWER FROM BOTH THE CHARGER AND THE BATTERY
EPS052-HVX	EPS052-H	LOSS OF DC POWER FROM BOTH THE CHARGER AND THE BATTERY
EPS052A-FLS	EPS052AF	NO DIV C AC POWER TO OR FAIL OF CHGR 1E22*S001CGR
EPS054-DG	EPS054-D	LOSS OF DC PWR
EPS054-FLS	EPS054-F	LOSS OF DC PWR
ESP061-NOAC	EPS061-N	LOSS OF 125V DC DIVISION A. (AT NORMAL BUS 1BYS*SWG01A)
EPS062A-NOAC	EPS062-N	LOSS OF DC POWER FROM BOTH THE CHARGER AND THE BATTERY
EPS062A-NOAC	EPS062AN	NO AC POWER TO OR FAIL OF CHGR 1BYS*CHGR1A
EPS071-HVX	EPS071	LOSS OF DIV II NORMAL 125V DC POWER FROM 1BYS*PNL02B

Table A-1. River Bend Fault Tree Gate Name Changes - PRA/IPE versus IRRAS. (Continued)

PRA/IPE Gate Name	IRRAS Gate Name	Gate Description
EPS072-HVX	EPS072	LOSS OF DC POWER FROM BOTH THE CHARGER AND THE BATTERY
EPS072A-HVX	EPS072A	NO AC POWER TO OR FAILURE OF CHGR 1BYS*CHGR1B
EPS074-HVX	EPS074	LOSS OF 125V DC TO NORMAL DC BUS 1BYS*SWG01B
ESF041-CSH	ESF041-C	ESFAS (HPCS) AUTO ACTUATION SIGNAL FAILS
IAS0003-HVX	IAS0003H	NORM OPER TR A FAILS TO MAINTIAN FLOW AND TR B & C FTR
IAS001-HVX	IAS001-H	LOSS OF INSTRUMENT AIR MOTOR-DRIVEN COMPRESSORS
IAS001-R1	IAS001-R	LOSS OF INSTRUMENT AIR SYSTEM
IAS001-R1-HVX	IAS001RH	LOSS OF INSTRUMENT AIR SYSTEM
IAS002-HVX	IAS002-H	LOSS OF INSTRUMENT AIR SYSTEM COMPRESSOR TRAINS
IAS002-R1	IAS002-R	LOSS OF INSTRUMENT AIR SYSTEM COMPRESSOR TRAINS
IAS0030-HVX	IAS0030H	IAS TRAIN C FAILS TO START AND MAINTAIN FLOW
IAS004-R1	IAS004-R	LOSS OF INSTRUMENT AIR DIESEL DRIVEN COMPRESSORS
IAS0090-HVX	IAS0090H	1-COMPRESSOR RUNNING AND SERVICE AIR FAILS TO ISOLATE
IAS0090-R1	IAS0090R	1-COMPRESSOR RUNNING AND SERVICE AIR FAILS TO ISOLATE
IAS0091-HVX	IAS0091H	ONE COMPRESSOR RUNNING
ICS003-SBO	ICS003-S	NO FLOW THROUGH VLV F013
ICS004-SBO	ICS004-S	RCIC PMP FAILS
ICS007-SBO	ICS007-S	RCIC TDP OR STM SUPP FAILS (RCIC FAIL TO START)
ICS011-SBO	ICS011-S	RCIC FAILS TO TRIP ON HIGH RPV LEVEL (LEVEL 8)
ICS011A-SBO	ICS011AS	OP FAILS TO CONTROL RCIC AND RCIC DOES NOT TRIP ON LEVEL 8
ICS023-SBO	ICS023-S	NO SIGNAL TO START RCIC
	ISOLATE	INTERFACING LOCA ISOLATED
	L	BREAK ISOLATION

Table A-1. River Bend Fault Tree Gate Name Changes - PRA/IPE versus IRRAS. (Continued)

PRA/IPE Gate Name	IRRAS Gate Name	Gate Description
	LCI36B	AUTOMATIC INITIATION AND OP ACTION FAIL TO START LPCI
	LCI4B	AUTOMATIC INITIATION AND OP ACTION FAIL TO START LPCI
	M	SRV'S OPEN
	NOADS	ADS INHIBIT
	P1	FAILURE OF ONE SRV TO RECLOSE
	P2	FAILURE OF TWO SRVs TO RECLOSE
PCSM007AA	PCSM07AA	FALURES OF LCV103
	RDS001-U	INSUFF FLOW TO RX FROM CONTROL ROD DRIVE (CRD)
	RDSM01	CRD FLOW FAILS DUE TO CONT VLV FAILURE OR OP ACTION
	ROD	MANUAL ROD INSERTION
	RPSE	REACTOR PROTCTION SYSTEM - ELECTRICAL
	RPSM	REACTOR PROTCTION SYSTEM - MECHANICAL
	RPT	RECIRC PUMP TRIP FAILURE 1E-3 * BETA=0.19
	RUPTURE	PIPE RUPTURE OCCURS
	SCRM	MANUAL SCRAM
	SIZE	SIZE OF RUPTURE SMALL OR LARGE
	SMALL	PRESSURE BOUNDARY PUMP SEAL GASKET FAILS
	SPC	SUPPRESSION POOL COOLING
SWP003-FLS	SWP003-F	LOSS OF COOLING WATER TO DG EG1C JACKET
SWP003A-CSH	SWP003AC	FAIL OF COOLANT FLOW TO HPCS DG ES001
SWP003C-CSH	SWP003CC	FAIL OF COOLANT FLOW TO HPCS DG ES001 THRU EDG-1A PATH
SWP003D-CSH	SWP003D	FAILURE OF COOLANT FLOW TO HPCS DG ES001 THRU EDG-E1B PATH
SWP003E-CSH	SWP003EC	FAIL OF HPCS DG ES001 COOLANT DISCH THRU EDG-E1A DISCH

Table A-1. River Bend Fault Tree Gate Name Changes - PRA/IPE versus IRRAS.

(Continued)

PRA/IPE Gate Name	IRRAS Gate Name	Gate Description
SWP100A-CSH	SWP100AC	FAIL OF STBY SERVICE WATER SUPPLY TRAIN "A"
SWP100A-DG	SWP100AD	FAIL OF SSW WATER SUPPLY OR DISCH - TRAIN "A"
SWP100A-DG-CSH	SWP10ADC	FAILURE OF STANDBY SERVICE WATER SUPPLY TRAIN "A"
SWP100B-CSH	SWP100BC	FAIL OF STBY SERVICE WATER SUPPLY OR DISCH. TRAIN "B"
SWP100B-DG	SWP100BD	FAIL OF STBY SERV WATER SUPPLY OR DISCH TRAIN "B"
SWP101A-HVX	SWP101AH	LOSS OF NSW FLOW TO SERVICE WATER HDR "A"
SWP101B-HVX	SWP101BH	LOSS OF NSW FLOW TO SERVICE WATER HDR "B"
SWP102A-HVX	SWP102AH	LOSS OF NSW FLOW TO THE NSW DISCH HDR
SWP105-HVX	SWP105-H	INSUFFICIENT FLOW FROM NSW PMP TRAIN "C"
SWP106A-CSH	SWP106AC	LOSS OF STBY SERVICE WATER FLOW TO SW HDR "A"
SWP106A-DG	SWP106AD	LOSS OF STBY SERVICE WATER FLOW TO SW HDR "A"
SWP106A-DG-CSH	SWP06ADC	LOSS OF STBY SERVICE WATER FLOW TO SW HDR "A"
SWP107A-CSH	SWP107AC	INSUFFICIENT SSW FLOW TO CHECK VLV SWP-V172.
SWP107A-DG	SWP107AD	INSUFFICIENT SSW FLOW TO CHECK VLV SWP-V172.
SWP107AA1	SWP07AA1	INSUFFICIENT FLOW FROM SSW PUMP TRAIN "A"
SWP107AA1-CSH	SWP07A1C	INSUFFICIENT FLOW FROM SSW PUMP TRAIN "A"
SWP107AA1-DG	SWP07A1D	INSUFFICIENT FLOW FROM SSW PUMP TRAIN "A"
SWP108AB-CSH	SWP08ABC	SERVICE WATER PUMP TRAIN C FAILS DUE TO INDEPDANT OR SUPPORT FAILURES
SWP108AB-DG	SWP08ABD	SERVICE WATER PUMP TRAIN C FAILS DUE TO INDEPENDENT OR SUPPORT FAILURES
SWP117-HVX	SWP117-H	INSUFFICIENT FLOW FROM SW COOLING PMP TRAIN "C"
SWP200A-HVX	SWP200AH	FAIL OF NSW SUPPLY OR DISCH. TRAIN "A"
SWP200B-HVX	SWP200BH	FAIL OF NSW SUPPLY OR DISCH. TRAIN "B"
SWP206A-FLS	SWP206A-F	FAILURE OF STANDBY SERVICE WATER DISCHARGE PATH "A"
SWP206A-CSH	SWP206AC	FAIL OF STBY SERVICE WATER DISCH PATH "A"

Table A-1. River Bend Fault Tree Gate Name Changes - PRA/IPE versus IRRAS.

(Continued)

PRA/IPE Gate Name	IRRAS Gate Name	Gate Description
SWP206A-DG	SWP206AD	FAIL OF STBY SERVICE WATER DISCH PATH "A"
SWP206A-FLS	SWP206AF	FAIL OF STBY SERVICE WATER DISCH PATH "A"
SWP206B-CSH	SWP206BC	FAIL OF STBY SERVICE WATER DISCH PATH "B"
SWP206A-DG-CSH	SWP26ADC	FAIL OF STBY SERVICE WATER DISCH PATH "A"
SWP300A-SBO	SWP300AS	SBO DOES NOT OCCUR OR DISCH VLV 1SWP-VF055C FAIL TO OPEN
SWP301A-SBO	SWP301AS	DISCH VLV 1SWP*AOV55C FAILS TO OPEN
SWP99A-HVX	SWP99A-H	FAIL OF NORMAL & STBY SW SUPPLY AND DISCH HDRS TRAIN "A"
SWP99B-DG	SWP99B-D	FAIL OF NORMAL & STBY SW SUPPLY AND DISCH HDRS TRAIN "B"
SWPM03B-CSH	SWPM03BC	FAIL OF HPCS DG ES001 COOLANT DISCHARG THRU A OR B
SWPM102-HVX	SWPM102H	LOSS OF NSW FLOW TO THE NSW DISCH HDR
SWPM112-HVX	SWPM112H	LOSS OF SERVICE WATER COOLING TO NSW DISCH HDR
SWPM113-HVX	SWPM113H	LOSS OF SERVICE WATER COOLING FLOW FROM SWC PMPS
	T	TRANSFER TO TRANSIENT EVENT TREE
	U3'	INSUFF FLOW TO THE REACTOR FROM CRD SYSTEM. ONE PMP
	U3X	INSUFF FLOW TO THE REACTOR FROM CRD SYSTEM. ONE PMP
	U4	FAIL OF THE FEEDWATER SYSTEM. 200 GPM MAKEUP
	U4'	FAIL OF THE FEEDWTAER SYSTEM . 800 GPM MAKE UP
	U4X	FAIL OF THE FEEDWTAER SYSTEM . 800 GPM MAKE UP
	V1	FAIL OF COND SYS INJ INTO VESSEL (200 GPM MAKEUP TO HOTWELL)
	V1'	FAIL OF COND SYS INJ INTO VESSEL (800 GPM MAKEUP TO HOTWELL)

Table A-1. River Bend Fault Tree Gate Name Changes - PRA/IPE versus IRRAS. (Continued)

PRA/IPE Gate Name	IRRAS Gate Name	Gate Description
	V1X	FAIL OF COND SYS INJ INTO VESSEL (800 GPM MAKEUP TO HOTWELL)
	V3	FAIL OF LPCI SYS TO INJ WATER INTO REACTOR WITH 1 OF 3 PMPS
	V3"	FAIL OF THE LPCI SYSTEM . TRAIN A ONLY
	V3'	FAIL OF LOW PRESS COOLANT INJECT SYSTEM. TRAINS B & C
	V3A	FAIL OF THE LPCI SYSTEM . TRAIN A ONLY
	V3BC	FAIL OF LOW PRESS COOLANT INJECT SYSTEM. TRAINS B & C
	V4	FAIL OF RPV COOLANT INJECTION WITH STBY SERVICE WATER
	V4'	FEEDWATER
	X3	DEPRESSURIZE TO MITIGATE LOCA