| | | | |
|---|---|---|---|
| h:\wp\<br>Effective date: 00/00/00 Print: 12/4/95 | **0PGP02-ZA-XXXX** | **Rev. 0**<br>**General** | Page 1 of 12 |
| **PROBABILISTIC SAFETY ASSESSMENT PROGRAM** | | | |
| Quality | Safety-Related | Usage: **DRAFT** | Effective Date: 1/02/96 |

| | | | |
|---|---|---|---|
| C. R. Grantom | (name) | (name) | Nuclear Fuel & Analysis |
| PREPARER | TECHNICAL | USER | COGNIZANT ORGANIZATION |

Table of Contents Page

DRAFT

## 1.0 Purpose and Scope

To define the structure, functions, controls, and applications of the South Texas Project (STP) Probabilistic Safety Assessment (PSA) program. This procedure is applicable to structures, systems, components, and human actions within the scope of the PSA for all plant operating modes and configurations are applicable to this procedure. The PSA program includes the STP Level 1 PSA (Reference 1), the Level 2 PSA/IPE (Reference 2), updates to these models, and analyses performed using these models.

The control elements associated with the STP PSA program are:

- Configuration Control;
- Software Control; and
- Application Control.

These elements provide the necessary controls to establish risk-based analyses performed at STP and to ensure that they contain appropriate technical bases and are documented with respect tc plant design, procedural processes, and plant performance. The relationship between these control elements is show in Figure 1.

## 2.0 Definitions

2.1 Configuration Control - activities necessary to identify, evaluate, and disposition changes or revisions to items containing PSA inputs.

2.2 Software Control - activities related to maintaining computer software configuration control.

2.3 Application Control - activities related to updating or revising risk-based evaluations or other risk-based deliverables within the scope of PSA models, as appropriate.

## 3.0 References

3.1 Level 1 PSA
3.2 Level 2 PSA/IPE
3.3 Fire PSA Update
3.4 Risk-Based Evaluation of Technical Specifications
3.5 PLG's Appendix B Software QA Program
3.6 ORAM Model Documentation.
3.7 STP Probabilistic Shutdown Safety Assessment

## 4.0 Responsibilities

Supervisor, Risk & Reliability Analysis assures that the requirements of this procedure are satisfied.

## 5.0 Requirements

### 5.1 Configuration Control of the PSA

#### 5.1.1 Scope of Analyses

PSA configuration control is comprised of the following areas:

- Risk Models and Documentation;
- Data Analysis;
- Methodology; and
- Assumptions

The STP PSA Program provides plant specific risk analyses of the STP units. Date and time stamps are used to establish the status of plant design and processes at the time of any analysis applicable to the PSA Program. The date and time stamps provide traceability of the results of a PSA analysis to the plant configuration at the time the analysis was performed.

#### 5.1.2 Risk Models and Documentation

Risk model documentation includes identification of references and other materials used to establish and model the response of the plant to various initiating events, operator actions, and recovery actions. Key components of risk model documentation include:

- Plant Models;
- System Models;
- Spatial Interactions Analysis; and
- System Success Criteria.

##### 5.1.2.1 Plant Models

At the plant level, event trees are used to model the response of the plant to an initiating event (e.g., plant trip). Event trees include important systems and operator actions necessary to prevent core damage. Quantification of event trees provides the likelihood of core damage given an initiating event. The STP PSA event trees and their relationships are shown in Figure 2. Event tree notebooks are maintained, and generally contain the following information:

- *Introduction* - describes event tree purpose and scope;
- *Assumptions/References* - lists assumptions and references from which they are derived;
- *Event Sequence Diagram* - (Front-line System Event Trees only) outlines equipment and operator actions required to mitigate/prevent a core damage event;
- *Event Sequence Block Descriptions* - (Front-line System Event Trees only) describes functional blocks contained in the event sequence diagrams;
- *Event Tree* - outlines succession of individual events which identify all possible sequences of events leading to a predefined failure event (e.g., core damage);
- *Fault Tree* - outlines top events which illustrate the logical relationship of the events leading to a particular event;
- *Macros* - defines split fraction logic rules used to link event trees;
- *Event Tree Top Event Descriptions* - defines systems, equipment, and operator actions included in the event tree structure;
- *Event Tree Binning Rules* - defines logic rules to group event tree sequences into common impacts for linking the next stage of event trees; and
- *Split Fraction Rules* - describes logic rules used to determine which split fractions should be assigned to a unique point in the event tree.

#### 5.1.2.2 System Models

On a system level, analyses are used to quantify the availability/reliability of plant equipment important to safety. Top events are defined for each system or function in terms of that system's success criteria. Fault trees are used to develop cutsets which lead to failure of a top event. The generated cutsets are modified to account for common cause failures, test and maintenance alignments, and unique boundary conditions.

System notebooks are developed to document the system models and their associated fault trees. Systems with components modeled in the

PSA are shown in Figure 3 along with their respective system notebooks. The system notebooks generally contain the following information:

- *Introduction* - describes fault tree purpose and scope;
- *System Function* - describes the process or purpose of the system;
- *Top Event Definitions* - defines the events for which system analysis provides quantification information;
- *System Success Criteria* - defines the minimum level of performance that will result in the system successfully performing its intended safety function as required by the event trees;
- *Support Systems* - defines systems and equipment which are required to successfully perform their function so that the analyzed system is capable of performing its intended safety function;
- *Systems Supported* - defines systems and equipment which depend on the analyzed system to perform its function so that they can perform their intended safety functions;
- *System Operations and Special Features* - defines pertinent information for normal operations and other characteristics which impact the analysis;
- *Potential for Initiating Event* - provides screening for the systems ability to cause an initiating event (e.g., reactor trip, turbine-generator trip);
- *Technical Specification Requirements* - provides information for success criteria and frequency of testing alignments;
- *Plant Procedures* - lists procedures used to define system alignments;
- *Assumptions* - lists items necessary to document areas not analyzed in part or in whole;
- *System Boundary* - defines the limit of the analysis relative to a physical of programmatic boundary;
- *Event Trees and Event Tree Split Fractions* - lists cross-references of the analyzed system to the associated event trees and split fractions;
- *Basic Event Cross Reference* - translates fault tree basic events to equipment descriptions and identification numbers;
- *Common Cause Modeling* - describes modeled common cause groups;
- *Maintenance Alignments* - describes the system configuration (including frequency and duration) when certain maintenance or testing activities are performed;
- *Recovery Factors Based on System Split Fractions* - lists operator actions necessary to restore the system or functions following failure of the analyzed system;
- *Modeling Notes* - provides other information relative to the system analysis;

- *Fault Tree* - outlines the graphical fault tree; and
- *References* - documents materials used in the system analysis.

#### 5.1.2.3 Spatial Interactions Analysis - Scope and Overview

Internal plant hazards (e.g., internal floods, plant fire, or seismic response) are highly dependent on the location of risk-significant equipment relative to the hazard. Due to this dependence on plant geometry, the identification and screening of scenarios caused by internal plant hazards is referred to as Spatial Interactions Analysis. To perform this analysis, the sources of hazards within the plant and the available hazard mitigative features are tabulated. Then, by starting with the hazard sources and taking the potential propagation paths and mitigative feature into account, environmental hazard scenarios are constructed for each location[1]. Computerized methods are used to analyze this data and to determine the frequencies of the scenarios occurring. Finally, a list is generated of scenarios ranked by their contribution to the occurrence of various impact vectors[2]. The STP spatial interactions analysis is documented in the Level 1 PSA (Reference 1), the Level 2 PSA/IPE (Reference 2), and in the Fire PSA update (Reference 3).

#### 5.1.2.4 System Success Criteria

System success criteria are generally based on analyses performed to determine plant response to a UFSAR Chapter 15 accident (e.g., Large LOCA, with single failure assumed) or a scenario defined in the Fire Safe Shutdown Report. Any analyses which modify the system success criteria are documented in the success criteria section of each system notebook.

### 5.1.2 Data Analysis - Scope and Overview

Data used in the PSA consists of generic data and plant-specific data. The generic data used in the Level 1 STP PSA quantifications performed in 1988 and 1989 was provided by PLG. Inc. Since then, selected plant-specific data has been incorporated into the PSA. In 1993, a successful comprehensive effort was made to perform a full scope update of plant-specific failure data. Future updates are planned for each

[1] A "location" means a well-defined volume in the plant that does not overlap another location. In general, fire zones as defined in a Fire Hazards Analysis are a good starting point for locations used in Spatial Interaction Analysis.

[2] Impact vectors are combinations of system success/failure, initiating events, and event tree top events.

Unit 1 refueling outage, and these updates will also be used as an input for Maintenance Rule (10CFR50.65) compliance. The types of data which can be updated include:

- equipment failure rates;
- human performance assumptions;
- initiating event frequencies (internal and external events);
- planned and unplanned maintenance frequencies;
- planned and unplanned maintenance durations;
- testing frequencies and durations;
- common cause failure rates; and
- other performance data (e.g., fraction of time supplemental purge valves are open; fraction of time PORV block valves are closed, etc.)

### 5.1.3 PSA Methodology

Probabilistic methods and techniques used in the original STP PSA are documented in the Level 1 PSA, the Level 2 PSA/IPE, and the Risk Based Evaluation of Technical Specifications (Reference 4). New PSA methodology will be incorporated on a case-by-case basis depending upon its applicability to STP.

### 5.1.4 PSA Assumptions

Assumptions made in the Level 1 PSA and Level 2 PSA/IPE range from those concerning construction of plant systems/equipment to those associated with plant transient and accident response. Documentation of assumptions made in the PSA are individually documented in the Level 1 PSA, Level 2 PSA/IPE, event tree notebooks, plant system notebooks, or other documents, as appropriate.

## 5.2 PSA Software Control

### 5.2.1 Scope and Overview

Only the software used to quantify and document quality risk-based calculations is included within the scope of this procedure.

The at-power (Mode 1) risk analysis performed at STP uses RISKMAN, a proprietary software program developed by PLG, Inc. A site license is maintained for RISKMAN in order to perform plant level event tree and system level fault tree quantifications.

The probabilistic safe shutdown analysis (PSSA) at STP uses the EPRI code ORAM (Outage Risk Assessment Module). ORAM is used for PSA analyses when the STP units are in Modes 4, 5, 6, or defueled. Plant conditions during shutdown configurations are evaluated by ORAM using qualitative and quantitative analyses. Documentation of STP's PSSA models is contained in Reference 6. ORAM software control is provided by EPRI and Erin Engineering, Inc.

5.2.2 Software Configuration Control

Configuration control of RISKMAN and verification and validation (V&V) requirements are maintained by PLG, Inc., pursuant to 10CFR50, Appendix B. The STP PSA program takes credit for PLG's Appendix B program with respect to software configuration control and V&V (Reference 5). To ensure that RISKMAN properly performs risk-based calculations at STP, a test case with a known input and output is run to document the accurate installation and performance of RISKMAN on STP PC workstations. Performance of the test case is documented per QA document in the RISKMAN Software.

5.2.3 Software Development and Enhancement

STP is also a member of the RISKMAN Technology Group (RTG), which is a user group comprised of utilities and national laboratories who use RISKMAN. Further development and application of RISKMAN and RISKMAN code maintenance are directed by the RTG. By participating in the RTG, STP is involved in the identification and correction of software errors as well as other RISKMAN enhancements.

5.3 PSA Application Control

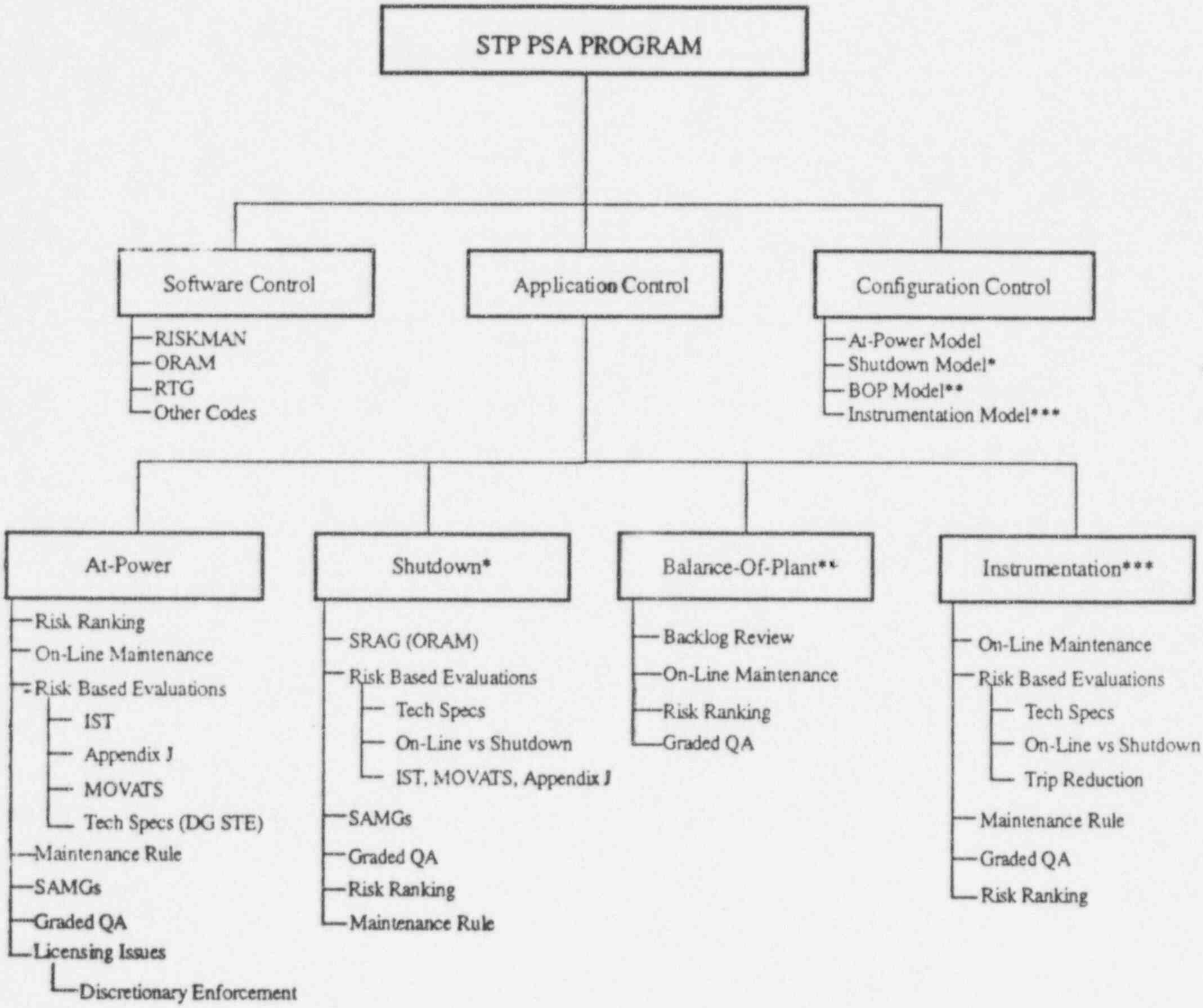
Control of PSA applications at STP is accomplished by ensuring that the PSA model and required changes used for the application are appropriate. The technical basis and changes required by the analysis are reviewed, approved, and documented. This provides adequate traceability and control.

6.0 Documentation

6.1 Selected Stand-Alone Reports or other risk based analyses, as required, are submitted to requesting organizations and to STP Records Management Services.

6.2 Periodic Reports updates to existing applications, as required, are submitted to client organizations and to STP Record Management Services.

## FIGURE 1
## PSA CONTROL ELEMENTS



* Presently Underway
** Part of Graded QA
***Business Plan Initiative

## FIGURE 2
## PSA EVENT TREES

### STP PSA PLANT EVENT TREE MODEL

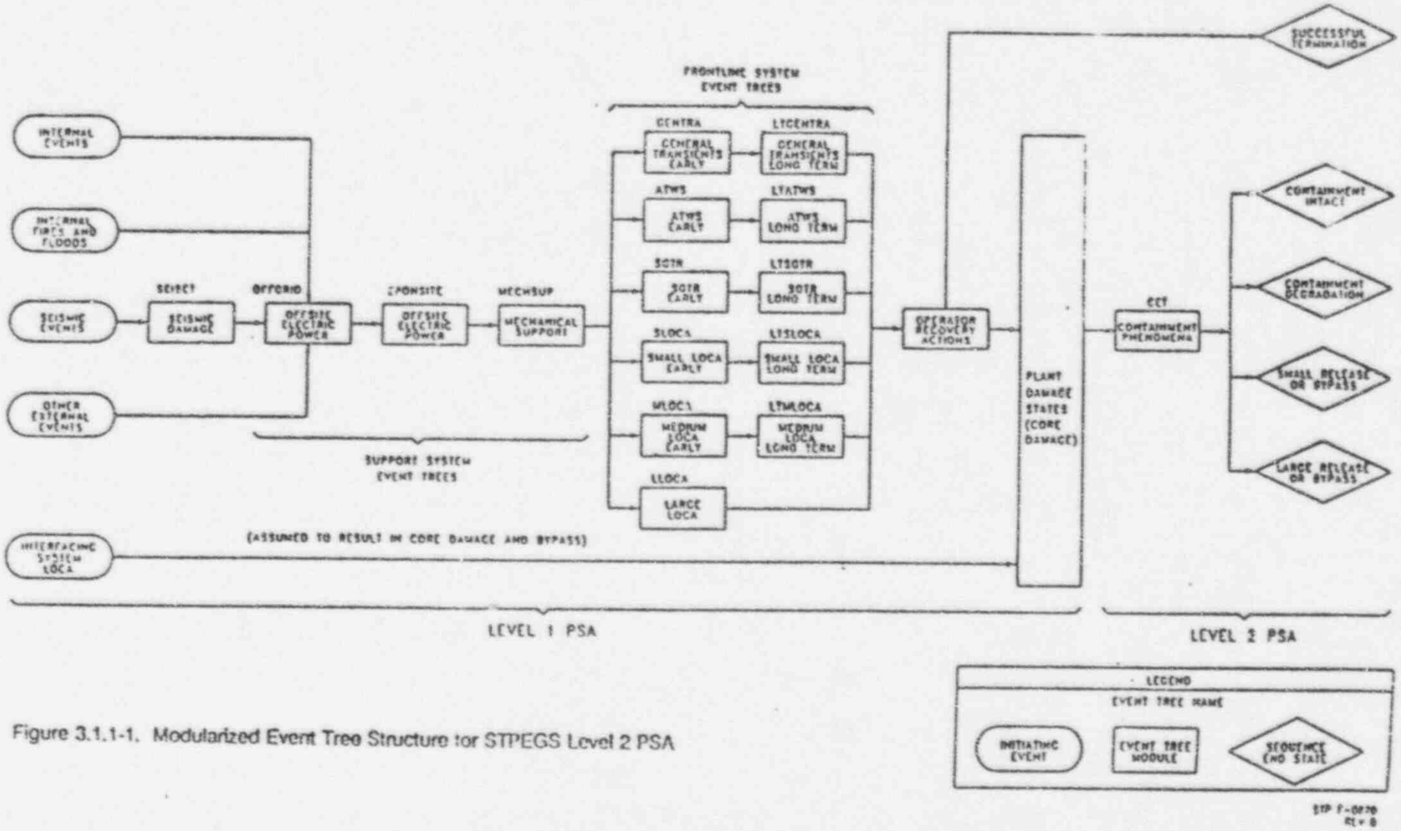


Figure 3.1.1-1. Modularized Event Tree Structure for STPEGS Level 2 PSA

MLP. SEC_3-1A IPE

3.1.1-3

REV. 0 (06-23-92)

DRAFT

## FIGURE 3
## SYSTEMS MODELED IN THE PSA

| | | |
|---|---|---|
| AC | Closed Loop Auxiliary Cooling Water | Select components modeled |
| AF | Auxiliary Feedwater System | Explicitly modeled |
| AM03 | QDPS | Select components modeled |
| CC | Component Cooling Water | Explicitly modeled |
| CH | Essential Chilled Water System | Explicitly modeled |
| CS | Containment Spray | Explicitly modeled |
| CT | Condensate Storage & Transfer | Select components modeled |
| CV | Chemical Volume and Control System | Explicitly modeled |
| DB | Diesel Generator (BOP, TSC, & EOF) | Select components modeled |
| DC | 250V DC Non-class 1E | Select components modeled |
| DG | Diesel Generator System | Explicitly modeled |
| DI | Standby Diesel Combustion Air Intake | Implicitly modeled in DG |
| DJ | 125V DC Class 1E | Explicitly modeled |
| DO | Standby DG Fuel Oil Storage & Transfer | Implicitly modeled in DG |
| DX | Standby Diesel Generator Exhaust | Implicitly modeled in DG |
| ED | Radioactive Vents & Drains | Containment Isolation only |
| EH | Electro-Hydraulic Controls | Select components modeled |
| EW | Essential Cooling Water | Explicitly modeled |
| HC | HVAC - Containment Building | Explicitly modeled |
| HE | HVAC - Electrical Auxiliary Building | Explicitly modeled |
| HG | HVAC - Standby DG Bldg | Select components modeled |
| HM | HVAC - MAB | Select components modeled |
| HZ | HVAC - Miscellaneous | Select components modeled |
| IA | Instrument Air | Select components modeled |
| JW | Standby DG Jacket Water | Implicitly modeled in DG |
| LU | Standby DG Lube Oil | Implicitly modeled in DG |
| MS | Main Steam System | Explicitly modeled |
| PA | Standby Transformer | Explicitly modeled |
| PB | Main & Auxiliary Transformers | Explicitly modeled |
| PC | 13.8 kV AC Auxiliary | Explicitly modeled |
| PE | 480 V AC Non-class 1E Load Centers | Select components modeled |
| PF | 480 V AC Non-class 1E | Select components modeled |
| PG | 13.8 KV Emergency Power | Explicitly modeled |
| PK | 4 kV AC Class 1E Power | Explicitly modeled |
| PL | 480 V AC Class 1E Load Center | Explicitly modeled |
| PM | 480 V AC Class 1E MCC & Distribution Panels | Explicitly modeled |
| RA | Radiation Monitoring | Containment Isolation only |
| RC | Reactor Coolant System | Explicitly modeled |
| RH | Residual Heat Removal System | Explicitly modeled |

## FIGURE 3
## SYSTEMS MODELED IN THE PSA

| | | |
|---|---|---|
| SB | Steam Generator Blowdown | Select components modeled |
| SD | Standby DG Starting Air | Implicitly modeled in DG |
| SF | Engineered Safety Features Actuation | Explicitly modeled |
| SI | Safety Injection System | Explicitly modeled |
| SP | Solid State Protection System | Explicitly modeled |
| VA | 120 V AC Class 1E Vital Power | Explicitly modeled |
| WL | Liquid Waste Processing | Containment Isolation only |
| XS | Switchyard | Select components modeled |