ENGINEERED SAFETY FEATURES

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6.0 ENGINEERED SAFETY FEATURES

Engineered safety features (ESF) are designed to mitigate the consequences of postulated design basis accidents (DBA) (notwithstanding the fact that these accidents are highly unlikely). The ESF function to limit, contain, control and terminate an accidental release of radioactive fission products, particularly as a result of accidents that could release large amounts of energy within the containment structure. ESF systems keep exposure levels to the public and plant personnel below applicable limits.

St. Lucie Unit 2 utilizes the following ESF systems:

a. Containment Structure (Subsections 6.2.1 and 6.2.3)

   The containment structure is a steel containment vessel surrounded by a reinforced concrete Shield Building. The two structures are separated by an annular air space. The containment vessel is a low leakage cylindrical steel shell with hemispherical dome and ellipsoidal bottom. The vessel is designed to contain the radioactive material that could be released from a loss of integrity of the reactor coolant pressure boundary. The Shield Building is a concrete structure which protects the containment vessel from external missiles, provides biological shielding, and provides a means of controlling radioactive fission products that could leak from the containment vessel if an accident should occur. Detail design information for the containment structure is presented in Subsection 3.8.2.

b. Containment Spray System (Subsections 6.2.2 and 6.5.2)

   The Containment Spray System removes heat from the containment by spraying water droplets through the containment atmosphere. The spray system is automatically initiated by the containment spray actuation signal (CSAS) which requires a coincidence of the safety injection actuation signal (SIAS) and the high-high containment pressure signal. The Containment Spray System consists of two redundant subsystems each consisting of a spray pump, a shutdown cooling heat exchanger and a spray header.

   When used with the Containment Cooling System to mitigate the consequences of the DBA, one containment spray subsystem along with two containment fan coolers provides 100 percent DBA heat removal capability.

   The Containment Spray System operates in conjunction with the Iodine Removal System which adds a hydrazine solution to the spray water in order to remove iodine from the containment post-DBA atmosphere.

c. Containment Cooling System (Subsection 6.2.2)

   The Containment Cooling System removes heat from the containment by passing containment air over coils cooled by the Component Cooling Water System.

The system consists of four cooling units each of which consists of cooling coils served by the Component Cooling Water System and an axial flow fan. During normal operation, three of the four units are in service.

On receipt of a SIAS, the fourth unit is automatically started. Two containment fan coolers, along with one containment spray subsystem, provide 100 percent DBA heat removal capability, as noted in part b) above.

d. Shield Building Ventilation System (Subsections 6.2.3 and 6.5.1)

The Shield Building Ventilation System (SBVS) maintains a negative pressure in the Shield Building annulus following a design basis accident, mixes Shield Building in-leakage, with the air in the annulus and with any leakage from the containment, and discharges it through a filter train which includes charcoal adsorbers. Also, the Fuel Pool Ventilation System is connected to the SBVS and maintains a slightly negative pressure in the Fuel Handling Building following a fuel handling accident in that building.

The SBVS consists of two full capacity redundant fan and filter systems located in the Reactor Auxiliary Building which filter air from the annular space and discharge through a vent stack to the atmosphere. On the suction side of each fan, the air is drawn sequentially through an electric heater, a demister, another electric heater, HEPA filter, charcoal absorber, and HEPA afterfilter. A backdraft damper is located on the discharge side of the exhaust fan to preclude backflow through the system. An automatically operated damper is also provided on the discharge side of the fan to control the flow at 6000 cfm when negative pressure is attained in the annulus or Fuel Handling Building.

Both full capacity fan and filter systems are automatically started upon receipt of a containment isolation actuation signal (CIAS) or a high radiation signal from the Fuel Handling Building. One fan-filter system can be manually shutdown and placed in a standby mode, whereby the standby system is automatically restarted if the operating system should fail.

e. Containment Isolation System (Subsection 6.2.4)

The containment isolation system isolates systems that pass through containment penetrations such that any radioactivity that may be released into the containment atmosphere following a postulated design basis accident is contained. The containment isolation system is required to function following, a DBA to isolate non-ESF systems penetrating the containment. Barriers are comprised of seismic Category I piping systems, both inside and outside the containment vessel, and manual and automatic isolation valves. Containment isolation is achieved upon receipt of a CIAS, thus limiting the potential radioactive releases.

f. Combustible Gas Control System (Subsection 6.2.5)

Combustible gas control in the containment following a DBA is accomplished by the use of the Hydrogen Sampling System in conjunction with the redundant, 100 percent capacity hydrogen recombiners.

The Hydrogen Sampling System analyzes the post-DBA containment atmosphere for potential hydrogen buildup via two redundant subsystems that are physically separate and independent of each other. When a hydrogen setpoint is reached, each of two 100 percent capacity redundant hydrogen recombiners are operated which limit the concentration to below the combustible limit. The recombiners process a flow of containment air containing hydrogen at a concentration typical of the average concentration throughout the containment.

The Hydrogen Sampling System and the hydrogen recombiners are operated manually from the control room.

g. Safety Injection System (Section 6.3)

Four safety injection tanks (SITs) provide a passive means of injecting emergency core cooling water into the reactor vessel. Each SIT is connected to one of the four reactor vessel inlet lines. Each SIT contains borated water at refueling concentration and is pressurized with nitrogen. In the event of a LOCA that results in Reactor Coolant System depressurization, the borated water is forced into the Reactor Coolant System (RCS) by the expansion of the nitrogen.

Active safety injection is provided whereby borated water from the refueling water tank is injected into the reactor vessel by two low pressure and two high pressure safety injection (LPSI and HPSI) pumps. The HPSI and LPSI pumps are actuated by a SIAS.

The design capacity from the combined operation of one high pressure pump, one low pressure pump and three safety injection tanks provides required core cooling for any size loss of coolant accident which results in RCS depressurization.

6.1 ENGINEERED SAFETY FEATURES MATERIALS

6.1.1 METALLIC MATERIALS

6.1.1.1 Materials Selection and Fabrication

Metallic materials for ASME Code Class 2 and 3 components are selected for their compatibility with the Reactor Coolant System and containment spray. The materials are described in ASME Code, Section III Articles NC-2160, NC-3120 and ND-2160, ND-3120 respectively and Appendix I to Section III. The mechanical properties of materials specified for use in Class 2 and 3 components are as indicated in ASME Code, Section III, Appendix I or ASME Code, Section II, Parts A, B or C. The pressure retaining materials of the ESF systems are included in Table 6.1-1.

Materials for ESF components listed below which are or may be in contact with core cooling and/or containment spray water are considered compatible with the cooling solutions:

a. Austenitic stainless steels and nickle base alloys are not subject to significant corrosion in borated water or borated water with hydrazine and trisodium phosphate additives.

b. Ferritic components are coated with protective coating systems as discussed in Subsection 6.1.2.

c. Galvanized steels do not represent a significant source of generated hydrogen, as discussed in Subsection 6.2.5.3.

Quality of ESF components is maintained during the stages of component manufacture and plant construction. Specific assurance of integrity is based on conformance with Regulatory Guides 1.31, 1.36, 1.37, and 1.44, as discussed in the following paragraphs.

Non-metallic insulation materials installed on stainless steel piping and equipment of the Engineered Safety Features have a low soluble chloride content to minimize the possibility of chloride induced stress corrosion. Combined leachable chloride and fluoride do not exceed 600 ppm. The insulation of ESF stainless steel piping and equipment conforms completely with the criteria of R.G 1.36, "Nonmetallic Thermal Insulation for Austenitic Stainless Steel," February 1973 (R0).

System cleanliness during construction, start-up (refer to Section 1.4.2) and operation is in accordance with Regulatory Guide 1.37, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants," March 1973 (R0).

ESF system components meet the intent of Regulatory Guide 1.44, "Control of the Use of Sensitized Stainless Steel," May 1973 (R0). The following requirements are included in the materials specifications for the prevention of sensitization in austenitic stainless steel components.

a. Nonsensitization of austenitic stainless steel material is verified for castings and for wrought materials which are either greater than two inches in wall thickness or are not water quenched after solution heat treatment.

   One sample from each production heat of material in a solution heat treatment lot is tested for acceptability under ASTM A262-70 Practice E, "Copper-Copper Sulfate - Sulfuric Acid Test," optionally screened by Practice A, "Oxalic Acid Etch Test."

b. Austenitic stainless steel castings and weld metal, are specified to contain a minimum of five percent delta ferrite.

c. Austenitic stainless steel piping which is subjected to heating above 300°F for bending or any purpose other than welding is resolution heat treated over the full length of pipe.

d. Welding practices for austenitic stainless steel components are controlled in the following manner: 1) the use of high heat input welding process is prohibited; 2) the maximum weld bead size is limited; and 3) the interpass temperature is limited to 350°F maximum.

e. Stainless steel components are cleaned, descaled, pickled, and passivated in accordance with the recommended practices of ASTM A380, "Standard Recommended Practice For Cleaning and Descaling Stainless Steel Parts,

Equipment and Systems," to protect against contaminants which are capable of causing stress corrosion cracking.

f. Stainless steel components are cleaned before and after welding to remove any contaminants, which may be capable of causing stress corrosion cracking. Aluminum oxide and/or silicon carbide grinding wheels and stainless steel wire brushes are limited to use on stainless steel only.

g. ESF water systems use deaerated water sources for makeup.

Austenitic stainless steels are provided in the solution annealed condition. Yield strength of the materials are of the order of 40,000 to 50,000 psi. Cold bent piping is resolution annealed after cold bending, except for the following conditions: 1) piping which is bent to a radius of at least 20 times the pipe diameter, in which case the resulting strain in the outer pipe fibers is under two percent, which causes no significant increase in yield strength; and 2) piping having two inch and smaller nominal size, normally operating at a temperature below 212°F and a pressure of below 150 psig, which have been subjected to a cold bending radius of at least five pipe diameters.

The delta ferrite content of welds in austenitic stainless steel ESF components is controlled, as a minimum, in accordance with the essential requirements of MTEB 5-1, "Interim Regulatory Position on Regulatory Guide 1.31," as follows:

a. Austenitic stainless steel filter metals are purchased to the acceptance test requirements of Section III of the ASME Code.

   Purchase orders specify an additional requirement: that austenitic stainless steel filler metals, other than SFA-5.4 Type 16-8-2, conform to an analysis demonstrating five to 20 percent ferrite to be present in undiluted weld deposits.

b. Flux bearing filler metals are tested for ferrite yield by chemical analysis using material obtained from weld metal test samples. Bare filler metals, to be deposited by inert gas shielded processes, have ferrite yield predicted from wire analysis. The analyses are applied to the Schaeffler Constitution Diagram for ferrite determination.

c. Weld metal test samples, required for flux bearing filler metals, are produced according to the method described in ASME Specification SFA-5.4. The acceptable ferrite range for filler metals is five to 20 percent. ASME SFA-5.4 Type 16-8-2 is excluded from this requirement.

d. The filler metal supplier makes chemical analysis tests, using material samples as required by the filler metal type. The analytical results are applied to the Schaeffler Constitution Diagram for ferrite determination.

e. The results of the analytical tests required are included in a Certified Materials Test Report, per the requirement of the ASME Code, Section III, NB-2130. The results of the ferrite determination are also included in the certified test report.

f. Production welds, with the exception of fillet welds having a throat dimension of 3/8 in. or under and butt welds in material with nominal thickness of 3/8 in. or under are tested for ferrite using magnetic permeability measuring equipment.

The instruments are calibrated from or traceable to those of the National Bureau of Standards, to the procedures described by the AWS Welding Research Document, dated July 1, 1972, "Calibration Procedures for Instruments to Measure Ferrite Content of Austenitic Stainless Steel Weld Metal," as supplemented by AWS Specification A4.2-74. Calibration of the instruments is performed on a weekly basis.

g. Magnetic testing for ferrite is performed about the circumference of pipe welds at 90 degrees or 1/4 weld length intervals on the weld centerline. The minimum required ferrite level, averaged over four readings, is three percent. The four ferrite determinations are not to include any ferrite values below one percent; any location yielding less than one percent ferrite is re-evaluated.

h. Only the minimum ferrite level criterion described above is used for weld acceptance standard.

i. In the event that the acceptable ferrite criterion is not met, a comparison of the weldment service requirements as related to the ASME criteria for fatigue strength, using conservative fatigue data representing weld metal containing fissures when available, is made to enhance the acceptance of low ferrite bearing weld metal.

j. As an alternate, low ferrite welds are examined for fissures. The test sample is a highly restrained flat position welded butt joint 4 x 4 x 1 inch thick, produced with those filler metals and using the parameters employed in the production weldment. The finished weld is sectioned at mid-length and one cut surface examined microscopically at 10X. A single tear or fissure defect less than 1/16 inch or a maximum of three defects, 1/64 to 1/16 inch in length within any 0.2 square inch area of weld metal, is acceptable.

k. Those production welds found unacceptable by the simulated weld tests are removed from the piping system, the joint rewelded and retested.

l. Production welds greater than one inch thick are evaluated for ferrite content according to the procedures and acceptance criteria stated above.

m. Production welds in the material nominal thickness range greater than 3/8 inch, to and including one inch, are tested on a sampling basis, according to the Table II of MTEB 5-1, "Interim Regulatory Position on Regulatory Guide 1.31."

n. Acceptable ferrite in the material thickness range greater than 3/8 inch, to and including one inch, is according to the procedures and acceptance criteria stated above.

o. Production butt welds in material with nominal thickness of 3/8 in. or under are not evaluated for ferrite content since there is no prior industry history of the occurrence of fissuring in welds of under 1/2 in. thickness.

Additionally, in various equipment/component orders and construction activities where it was possible to employ later criteria, the delta ferrite content of stainless steel welds is controlled in

accordance with the recommendations of Regulatory Guide 1.31, "Control of Ferrite Content in Stainless Steel Weld Metal," Revisions 2 and 3.

Combustion Engineering (CE) requires vendors to comply with delta ferrite limits given below for components within CE's scope of supply. Delta ferrite in austenitic stainless steel pressure retaining parts shall be controlled to the limits given for the appropriate material as follows.

a) All components except valves

1. Weld rod or filler metal: five to 20 percent by volume (5Fn to 23Fn), and,

2. Production Welds: not less than three percent by volume (3Fn).

3. Deposited weld metal, including overlay cladding, exposed to the temperature range of 800-1500 F subsequent to welding; five to 20 percent by volume (5Fn to 23Fn).

4. Delta ferrite in castings of types CF-3, -3A, -3M, -8M, shall be controlled to the following limits: five to 30 percent volume (5Fn to 35Fn).

Delta ferrite content of all production welds in austenitic stainless steel except for fillet welds with a minimum dimension of 3/8 inch or less and except for welds in material less than 1/4 inch thick are verified as follows:

a. Measurements are taken along the weld centerline at four equally spaced positions with a calibrated ferrite measuring instrument.

b. No single measurement shall be less than one percent by volume (1Fn) and the resultant average value will meet the acceptance limits 1) through 4) above.

Delta ferrite content austenitic stainless steel castings is measured and recorded for each casting or a 30 percent minimum random sample of each casting heat if quantity in heat is five or more. A calibrated magnetic measuring instrument is used at random locations on the actual castings.

b) Valves:

Delta ferrite control on valve material consists of requirements that austenitic stainless steel castings and deposited weld metal shall have a chemistry balanced to give five to 25 percent by volume delta ferrite on solidification. This is verified by measurement with a calibrated ferrite measuring instrument.

Sensitization of unstabilized stainless steel parts that are wetted by the process fluid (all 300 types except 321, 347 and 348) is controlled as follows:

1) All components except valves;

a. All raw material shall be supplied in the solution annealed condition.

b. Wrought material to be welded shall have a maximum carbon content of 0.065 percent.

c. Wrought material shall not be exposed to the temperature range of 800-1500 F except due to welding.

d. All unstabilized, austenitic stainless steel raw material, except castings are tested and pass ASTM Test Method A262-70, Procedure E.

2) Valves:

Valve specifications include the requirement that the valve supplier control sensitization during manufacturing process.

6.1.1.2 Composition, Compatibility and Stability of Core and Containment Spray Coolants

As indicated in Subsection 6.1.1.1, ESF materials are chosen to be compatible with the cooling solutions which consist of the following:

a. The Reactor Coolant System contains borated water with a chemistry as described in Subsection 9.3.4. Should a LOCA occur this water is ejected into the containment, and drains to the containment sump.

b. The refueling water tank (RWT) stores borated water as described in Subsection 6.3.2. Should a LOCA or Main Steam Line Break (MSLB) inside containment occur, a portion of the RWT water is injected into the RCS by the safety injection pumps and a portion is sprayed into containment by the Containment Spray System (reference Subsections 6.2.2 and 6.5.2). The containment spray solution is mixed with the Iodine Removal System water which contains trace amounts of hydrazine for iodine removal (Subsection 6.5.2). The hydrazine does not affect the pH of the spray solution.

c. Should a steam or feedwater break occur inside containment, demineralized feedwater pipe drains to the containment sump. Feedwater chemistry is discussed in Subsection 10.3.5.

The above sources of essentially pH neutral or slightly acidic borated water immerse and dissolve the solid trisodium phosphate dodecahydrate (TSP) emplaced in stainless steel mesh baskets located in the vicinity of the sump. Subsequently, within two hours post-accident, the recirculating water mixture is stabilized at a neutral pH in accordance with Branch Technical Position MTEB 6-1, "pH for Emergency Coolant Water." As a result, the pH level of the post-accident water chemistry reduces the probability of stress corrosion cracking of austenitic stainless steel components. Other ESF materials such as pump and valve seals designed for the cooling solutions remain unaffected by neutral pH water.

Potential hydrogen generation from possible corrosion of aluminum and zinc metals inside containment is discussed in Subsection 6.2.5.

Details on the storage of TSP and hydrazine, the post-accident pH time history, and related information pertaining to the Containment Spray/ Iodine Removal Systems, are provided in Subsections 6.2.2 and6.5.2. Borated water storage in the RWT is discussed in Subsection 6.5.2.

6.1.2 ORGANIC MATERIALS

Asphalt and wood are not used as materials of construction inside containment. Plastics present in containment are limited to an insignificant amount. The major lubricant present in significant amounts is the lube oil associated with the reactor coolant pumps, but this oil is contained in a closed system and is not exposed to the accident environment.

Insulation on the piping and equipment inside the containment is either reflective metallic type or conventional nonmetallic. Nonmetallic insulation inside the containment is jacketed with type 304 stainless steel. Jacketing covers the entire length of the insulation including valves and fittings, thus there is no exposed nonmetallic insulation to react with the borated water. Insulation is further discussed in Subsections 6.1.1.1 and 6.2.2.

Cable insulations are qualified to withstand the DBA environment. Insignificant amounts of polyvinyl chloride (PVC) insulation are used inside containment. Refer to Section 3.11 for further environmental qualification details concerning electrical equipment.

Protective coatings (paints) are applied inside the primary containment for decontamination purposes and the original plant coatings are listed in Table 6.1-2. In Service Level I areas, the significant coating quantities conform with the intent of ANSI Standards N512, "Protective Coatings (Paints) for the Nuclear Industry," June 1974, and N101.2, "Protective Coatings (Paints) for Light Water Nuclear Reactor Containment Facilities," May 1972. Service Level I areas are defined as those areas inside the containment vessel. Significant surface areas of concrete, masonry, and steel receive protective coatings successfully tested under DBA conditions. Nonqualified coatings represent an insignificant quantity. Qualifying tests were conducted at independent laboratories or at the coating manufacturers laboratories. Regulatory Guide 1.54 (R0) requires that the radiolytic and pyrolytic characteristics of the protective coatings are tested, analyzed, and certified, in accordance with the above ANSI Standards, that no decomposition products will be released such as to interfere with the safe operation of any engineered safety feature. The physical- chemical characteristics of the above protective coatings are ensured by tests, conducted per ANSI Standards N512 and N101.2, to show that combustible properties are at or below the acceptable level delineated in those ANSI Standards. Tests deemed necessary to demonstrate satisfactory performance have been conducted.

Application of field applied coatings is done in compliance with the recommendations of each product manufacturer and per approved site-coating procedures. Quality assurance during manufacturing, storage, application and inspection of field applied coatings meets the intent of ANSI Standard N101.4, "Quality Assurance for Protective Coatings Applied to Nuclear Facilities," Nov. 1972, in conjunction with the general QA requirements of ASME NQA-1-1994, and thereby are consistent with the requirements of Regulatory Guide 1.54, "Quality Assurance Requirements for Protective Coatings Applied to Water Cooled Nuclear Power Plants" June 1973.

Protective coatings were originally intended for a 40 year service life. Consistent with St. Lucie's response to NRC Generic Letter 98-04 (see Section 6.3.2.2.2a), visual inspections and condition assessments of Service Level 1 coatings inside the containment building are

performed every refueling outage. In the event that recoating is desired, the original coating is removed before application of any new coating. Note that coating parameters (i.e., thermal conductivity, thickness and volumetric heat capacity) are used in the accident analysis of Section 6.2.1.

The total amount of protective coatings and organic materials used inside the containment that do not meet the requirements of ANSI N101.2 (1972) and Regulatory Guide 1.54 is approximately 6 cubic feet. The amount of unqualified protective coatings is about 2.5 cubic feet. The equipment so coated is located in various parts of the containment. Although these coating schemes have not undergone DBA qualification testing, some of these coating schemes are baked on enamel which will not readily peel off under DBA environments. The remaining unqualified organic material is NUKEM 750 caulking material used as expansion joint filler (2.5 cubic feet) and miscellaneous organics (approximately 1 cubic foot). Use of NUKEM 750 was justified and was deemed acceptable by the NRC. [(1),(2)]

Evaluation of the effect of unqualified materials inside containment on combustible gas generation can be found in Subsection 6.2.5 and on ECCS sump strainer design in Subsection 6.2.2.

REFERENCES: SECTION 6.1

1) FP&L letter L-80-246 from Dr. R E Uhrig (FP&L) to Mr. R L Baer (USNRC), dated August 1, 1980

2) USNRC Letter Docket No. 50-389 from Mr B J Youngblood (USNRC) to Dr R E Uhrig (FP&L) dated November 7, 1980.

TABLE 6.1-1

PRINCIPAL ESF PRESSURE RETAINING
MATERIALS AND ESF STRUCTURAL MATERIALS THAT
COULD BE EXPOSED TO CORE COOLING OR CONTAINMENT SPRAY SOLUTIONS

1. CONTAINMENT SPRAY

a)	Pumps	ASTM-A-296 (CA6NM) -A-276 TP 410T ASME-SA-182 (F 304) -SA-194 GR. 7 -SA-193 (GR. B-7)
b)	Spray Nozzles	ASME-SA-351 GR CF8
c)	Piping Flanges/Fittings	ASME-SA-312 GR TP 304, 316/316L -SA-358 CL 1 Type 304 -SA-182 GR F304 -SA-351 GR CF8 -SA-403 GR WP 304W, 316/316LW
d)	Valves	ASME-SA-351 GR CF8M -SA-182 Type 316 -SA-564 Type 630
e)	Refueling Water Tank	ASME-SA-240 Type 304 -SA-182 Type 304 -SA-479 Type 304 -SA-403 Type 304W
f)	Sump Strainer	Stainless steel TP 304 Carbon steel

2. SAFETY INJECTION

a)	Piping Flange/Fittings		ASME-SA-312 GR TP 304 -SA-182 GR F 304 -SA-351 GR CF8 -SA-403 GR WP 304W
b)	Pumps		ASME SA-182 F304 ASTM A-296 CA6NM
c)	SDC Flow Control Valves		ASME SA-182 F316 ASME SA-351 CF8M
d)	Safety Injection Tanks	Heads:	ASME SA-516 GR-70 (W Aust. Stainless steel clad)
		Shell:	ASME SA-516 GR-70 (W SA 240 type 304L RB clad)
e)	Shutdown HX		ASME SA-249-TP-304

TABLE 6.1-1 (Cont'd)

3.	HVAC	
	a) Fan Coolers and SBVS	ASTM-A-36 -A-283
	b) Ducts	ASTM A-526 Coating Designation G90
	c) Valves	ASME-SA-516 GR 70, SA-240, SA-350
	d) Pipes	ASTM A-106
	e) Cooling Coils	ASME-SB-75, SB-42 and SB-12, Alloy 122, ASME-SB-466 Alloy 706
	f) Cooling Coil Frame	ASME-SA-240 Type 304
4.	COMBUSTIBLE GAS CONTROL	
	a) Pipes	ASTM-A-269 GR. TP. 316
	b) Valves	ASME-SA-240 Type 316 -SA-479 Type 316
5.	CONTAINMENT ISOLATION	
	a) Pipes	ASME-SA-106 GR B, GR C -SA-155 GR KC-65 -SA-312 GR TP 304 -SA-269 GR TP 304, 316 -SA-312 GR TP 316
	b) Valves	ASME-SA-479 GR 316, GR 304 -SA-351 GR CF8M -SA-216 GR WCC -SA-516 GR 70 -SA-516 GR 55 ASTM-A-216 GR WCB -A-217 GR WC9 -A-351 GR CF8M
6.	CONTAINMENT VESSEL*	
	a) Plate	ASME-SA-516 GR 70 -SA-240 Type 304
	b) Penetrations/Forgings	ASME-SA-350 GR LF1/LF2 -SA-333 GR 6 -SA-182 Type 304 -SB-166/167/168

*Containment vessel is covered by protective coatings (paints). (Refer to Subsection 6.1.2).

TABLE 6.1-2

PROTECTIVE COATINGS IN THE PRIMARY CONTAINMENT VESSEL[1]

SURFACE TO BE COATED	PRIMER OR SURFACER	DFT (mils)	FINISH COAT	DFT (mils)	APPROX. AREA (Sq. ft.)
A) Concrete walls, ceilings & equipment pedestals	Nu-Klad 1-14 Amercoat 90	Trace-7 2-4	Amercoat 90 Amercoat 90	4-8 3-5	66,927
B) Concrete floors	Nu-Klad 110AA	65-125	Amercoat 90	4-8	25,350
C) Concrete underwater sumps	Nu-Klad 110AA	65-125 (not over 250)	N/A	N/A	907
D) Elec. tunnel floors	Nu-Klad 110AA	As above	Amercoat 90	4-8	5,400
E) Elec. tunnel walls & ceiling	Nu-Klad 114	Trace-7	Amercoat 90 Amercoat 66	4-8 4-8	
F) Carbon steel					
1) Containment Vessel (interior)	Carbo Zinc 11	2-7	Phenoline 305	4-8	86,700
2) Structural Steel (Equipment Supports)	Carbo Zinc 11 Mobilzinc 7 (13-F-12)	3.5 avg. 3.5 avg.	Amercoat 90 Amercoat 90	4-8 4-8	17,320
3) Embedded Plates	Carbo weld 11 Dimetcote 6	1-1.5 2-4	Amercoat 90 Amercoat 90	4-8 4-8	6,212
4) Main NSSS equipment valves, supports refueling machine, fuel trans. syst, RC motor stand	Carbo zinc 11	2-7	N/A	N/A	3,600
Safety inj. tanks,	Dimetcote 6	2-4	Amercoat 90	4-8	5,800
Head lift rig	Dimetcote E-Z	2-4	Amercoat 90	4-8	
motor op. valves, support & yoke	Carbo zinc 11	2-7	Phenoline 305	4-10	350
Stm. Gen. Snubbers (4)	Carbo Zinc 11	2-7	Carboline 3912	4	80
Stm. Gen. Snubbers (12), RC Pump motor	Plasite 7155NP	3	Plasite 7155	4	2,040

TABLE 6.1-2 (Cont'd)

PROTECTIVE COATINGS IN THE PRIMARY CONTAINMENT VESSEL[1]

SURFACE TO BE COATED	PRIMER OR SURFACER	DFT (mils)	FINISH COAT	DFT (mils)	APPROX. AREA (Sq. ft.)
5) Miscellaneous Equipment including polar crane, maint. hatch shield door, bulkhead doors, pipe whip restraints, conduit supports, reactor coolant pump supports, elect. tray supports, restraints, PC pipe sleeves, equipment restraints.	Carbo zinc 11	2-7	Mobil 89 Series	4-8	127,381
	Carbo zinc 11	2-5	Amercoat 90	4-8	
	Mobilzinc 7 (13-F-12)	2.5-5	Amercoat 90	4-8	
	Dimetcote 6	2.5-5	Amercoat 90	4-8	
	Carbo zinc 11	3.5 avg	Amercoat 66	4-8	
	Carbo weld 11	1-2	Amercoat 66	4-8	
	Dimetcote E-7	2-4	Amercoat 66	4-8	
	Carbo weld 11	1-2	Amercoat 90	4-8	
	Dimetcote 6	2-4	Amercoat 66	4-8	
Exhaust & supply fans, cont. fan coolers, reactor cavity pressure dampers, cont.duct pressure relief dampers, CS valves, check valves,strainers, hangers & restraints,sump pump, lighting and misc. transformers.	Mobilzinc 7 (13-F-12)	3-5	Mobil 89 Series	4-8	
	Carbo zinc 11	2-7	Phenoline 305	4-10	
	Phenoline 305	2-5	Phenoline 305	2-5	
	Amercoat 90	4-8	Amercoat 90	4-8	
6) Galvanized steel, including electrical trays, exposed conduit electrical boxes, duct dampers and louvers, duct, cable trays.	Zinc	0.8-3.5	N/A	N/A	123,944

Notes:

(1)
This table identifies the original coatings used within containment and is maintained here for informational purposes. Replacement coatings are required to be approved in accordance with the latest approved Engineering Specification for Service Level I coatings for application within the containment building.

6.2 CONTAINMENT SYSTEMS

The original analysis supporting the design of the St. Lucie Unit 2 containment was conducted by the Nuclear Steam Supply System (NSSS) vendor, Combustion Engineering, and the Architect Engineer (AE), EBASCO. Similar to the original design of most nuclear plant containments, the NSSS vendor supplied the mass and energy release data for a spectrum of Loss of Coolant Accidents (LOCAs) and Main Steam Line Breaks (MSLBs). This information was generated using NRC approved blowdown codes, now referenced in the Standard Review Plans (SRPs). This blowdown or mass and energy release information was used by the AE to generate the corresponding transient containment pressure and temperature response. For the St. Lucie Unit 2 dual containment (i.e. steel shell with annulus), the peak P/T values were considered with structural limitations to set the peak design pressure and temperature of the steel shell. The annulus design analyses, described later, were based on different assumptions assuming maximum heat transfer through the steel shell.

The peak containment design pressure is the pressure which the vapor space or containment atmosphere should not exceed. The peak containment design temperature, however, is the temperature which the steel shell should not exceed. While the forcing function for this temperature is the vapor space response, the equipment surface temperature is lagged and will generally not experience the elevated temperatures resulting from pure steam blowdown (i.e., MSLB) responses. The transient containment vapor space response is used as input to equipment qualification (EQ) analyses, which specify the environment within which Class 1E safety related equipment, must function. While the EQ analysis is described in other plant documentation, the temperature response produced during the design analysis, and presented in the UFSAR, is the prime input.

Due to the two-steam generator large inventory design of Combustion Engineering designed plants, the MSLB event typically produces the peak containment pressure and temperature. Depending on the analysis assumptions regarding the amount of moisture carryover in the steam release, the MSLB can also produce containment temperatures well in excess of the LOCA. These elevated temperatures, however, are typically of short duration and in most cases will not impact the operation of in-containment equipment or challenge the design structural temperature limit. The duration of the MSLB is also short, relative to the LOCA, and does not have the potential for a significant radiological release. As a result, the requirements for operation of post-accident safety related equipment are limited when compared to the long-term cooldown associated with the LOCA. For these reasons, the post-accident requirements for a LOCA were typically used as the basis for engineered safety feature equipment design, integrated leakage rate testing (ILRT) limits, and long term EQ requirements.

As can be inferred by the above discussion, the analysis of the LOCA requires a greater level of detail than the MSLB. While the MSLB transient largely consists of the blowdown phase, the LOCA is represented by four distinct phases. As described in greater detail in subsequent sections, these are characterized by the blowdown, reflood, post-reflood, and long term phases. As a result, the LOCA analysis requires the use of three different computer codes versus one for the MSLB.

The original analysis of the LOCA for St. Lucie Unit 2 plant was split by Combustion Engineering and EBASCO. A parametric study of break sizes was analyzed by Combustion Engineering using an early version of the NRC approved CEFLASH and FLOOD-MOD2 computer codes. These codes provided data from the initiation of the event through the end of blowdown for the

hot leg breaks and end of post-reflood for the cold leg breaks. The mass and energy release data associated with a sample of breaks was provided to EBASCO for the containment pressure and temperature response calculation. The long term phase was also conducted by EBASCO utilizing the primary and secondary conditions present at the end of these intervals. The assumptions associated with these analyses were based on plant conditions and Regulatory requirements present at that time. The most significant of these was the initial power level of 2560 MWt.

Following the initial FSAR writeup, a number of plant changes, Regulatory requirements, and methodology and modeling enhancements occurred. While these changes were addressed, they had been performed on a piecemeal basis. The current analysis (Ref. 27) discussed below was performed to consolidate prior updates and changes. This included a recalculation of all mass and energy release data and both the short and long-term containment pressure and temperature response. While many enhancements in methodology, computer codes, and inputs were incorporated, the bounds of the analysis were also extended. This extension was the modeling of the Component Cooling Water (CCW) and Intake Cooling Water (ICW) systems.

The CCW/ICW modeling was developed to address limiting CCW/ICW parameters for the St. Lucie Unit 2 plant. As described in subsequent sections, this modeling was an extension of ABB C-E's NRC approved CONTRANS containment code. While past containment analyses have assumed a fixed CCW temperature, this model simulated the transfer of containment heat through the CCW and ICW loops back to the ultimate heat sink. This model was developed and tested using FPL supplied data for St. Lucie Units 1 & 2. In this manner, fan cooler heat and shutdown cooling heat exchanger (SDCHX) capacity was a time varying function based on the transient calculation of Component Cooling Water temperature. For St. Lucie Unit 2, the additional heat loads of High Pressure Safety Injection (HPSI) pump and control room A/C were also added to the CCW loop. The prior considerations of peak accident heat load required for the conservative hand calculations of the past were no longer necessary or considered to be a critical parameter.

With this approach, the analysis took on a more realistic quality which coupled the old analysis bounds with those plant components and systems commonly assumed in the past as fixed inputs. Important items such as the ICW heat exchanger overall heat transfer coefficients, which addressed fouling and tube pluggage, along with more accurate ICW flow rates and ultimate heat sink temperature all served as design inputs to the analysis. Therefore, along with the typical plant analysis criteria of peak containment pressure and EQ temperature, the peak CCW temperature was also added.

The consolidated analysis was done in general accordance with the SRPs, with enhanced methods and inputs, resulting in the results showing a less severe response than those originally predicted. The coupled modeling of mass and energy release to containment and CCW/ICW response has provided a unique analysis of the overall plant performance during a design basis LOCA. The detailed analysis including summary of inputs, assumptions, and their bases is discussed in Reference (27).

The St. Lucie Unit 2 SGs have been replaced. The LOCA containment peak pressure and temperature analysis and MSLB containment peak pressure analysis demonstrated that the analyses of record remained bounding (see Reference 39).

GOTHIC (Generation of Thermal-Hydraulic Information for Containments) is an integrated, general purpose thermal-hydraulics software package for design, licensing, safety and operating

analysis of nuclear power plant containments and other confinement buildings. GOTHIC has been reviewed and approved by the NRC for use in containment analysis for analysis of LOCA and MSLB in large dry containments and was used for various analyses to support the replacement steam generators.

GOTHIC is further discussed in Reference 39.

St. Lucie Unit 2 has been evaluated for an EPU. The LOCA containment peak pressure and temperature analysis and MSLB containment peak pressure analysis have generated new bounding values as discussed below.

6.2.1 CONTAINMENT FUNCTIONAL DESIGN

6.2.1.1 Containment Structure

6.2.1.1.1 Design Bases

The containment is designed to provide protection to the public from the consequences of a loss of coolant accident (LOCA) up to and including a double-ended rupture of the largest reactor coolant pipe assuming unobstructed discharge from both ends coincident with the loss of offsite power and any single active component failure. The containment structure and the Engineered Safety Features ensure that potential radiological doses to the public resulting from such an occurrence are below the guidelines established for design basis accidents.

The spectrum of postulated accidents considered in determining the design containment peak pressure and temperature, the subcompartment peak pressure and the containment differential pressure used in the original analysis are summarized in Table 6.2-1. The spectrum of break sizes was chosen to establish the upper bounds of containment pressure and temperature following a DBA. For the Stretch Power Analysis only the worst main steam line break (MSLB) case was analyzed for Cycle 2, as presented in Table 6.2-63A. The updated limiting LOCA case is also presented for completeness. The containment peak pressure and temperature have been reviewed at the stretch power rating and are still within technical specification limits.

The EPU evaluation of peak containment pressure is a complete reanalysis. The three single failures, loss of one containment cooling train, failure of a MFIV to close and the failure of a MSIV to close were evaluated over a spectrum of power levels so the maximum containment pressure was identified. The MSLB EQ temperature response was based on the peak pressure case with the maximum temperature. The MSLB cases analyzed for EPU are provided in Table 6.2-63B.

The containment systems protect the public from the consequences of a postulated break in the Reactor Coolant System. The containment systems consists of the steel containment vessel surrounded by the Shield Building, and the engineered safety feature systems which include the Safety Injection System (Emergency Core Cooling System), the Containment Heat Removal System (Containment Spray System and Containment Cooling System), the Shield Building Ventilation System, the Containment Isolation System, and the Combustible Gas Control System.

A description of the containment and the design criteria relating to construction techniques, static loads, and seismic loads coincident with loss of coolant accident induced loads are

provided in Section 3.8. This section pertains to those aspects of containment design, testing, and evaluation that relate to the accident mitigation function.

The containment vessel is designed to withstand the pressure and temperature transients calculated to exist after a design basis accident (DBA). Post accident conditions are determined by evaluating the combined influence of the energy sources, heat sinks and Engineering Safety Features (ESF) operation.

The spectrum of postulated accidents considered in determining the design containment peak pressure and temperature, the subcompartment peak pressure, and the containment differential pressure are summarized in Table 6.2-1. The spectrum of break sizes was chosen to establish the upper bounds of containment pressure and temperature following a DBA. For postulated subcompartment pipe break accidents, a discussion of the criteria for selecting break locations is given in Subsection 6.2.1.2.

The accident controlling design for each of the categories of containment peak pressure, containment peak temperature, subcompartment peak pressure, containment differential pressure, and containment minimum pressure is that case which produces the most severe loadings for the spectrum of accidents postulated. The margin between values calculated for a DBA and design values is established by comparing Tables 6.2-2 and 6.2-3. Table 6.2-2 defines the DBA for each design category and Table 6.2-3 gives the margin and the formula for calculating margin.

For the containment peak pressure analysis, subcompartment peak pressure analyses, the containment peak temperature analysis, and the ECCS minimum containment pressure analysis, it is assumed that each accident is concurrent with the most limiting single failure. No two accidents are assumed to occur simultaneously or consecutively.

The time dependent mass and energy release for the postulated accidents under the categories of containment peak pressure and temperature analyses are referenced in Table 6.2-1. The computer codes and assumptions used in deriving each of the mass and energy release tables are discussed in Subsections 6.2.1.3 and 6.2.1.4.

Energy released to the containment atmosphere as a result of the postulated accidents is removed by the Containment Heat Removal System discussed in Subsection 6.2-2. Each train of the Containment Heat Removal System (consisting of one spray pump, one set of spray headers, one shutdown heat exchanger and two fan coolers) is designed for 100 percent of the required heat removal rate.

For the original containment analysis, the most limiting case with respect to containment peak pressure was the maximum safety injection case. The most restrictive single active failure was a loss of one spray train of the Containment Heat Removal System resulting in minimum heat removal capability. Only one containment spray train and four containment fan coolers of the Containment Heat Removal System were assumed to operate during the LOCA while the maximum safety injection conservatively maximized the LOCA energy release rate. The single active failure of one onsite diesel generator is not the most restrictive failure since safety injection would not be maximized. For the EPU containment analysis, the most limiting case with respect to containment peak pressure is the Double Ended Hot Leg Slot (DEHLS) break with the minimum safety injection case.

The current main steam line break (MSLB) DBA initiates from 0% power. The most limiting single active failure is determined to be the failure of one train of the Containment Heat Removal System with the availability of offsite power.

The containment peak temperature results from a DBA 100.3 percent power main steam line break. The most limiting single active failure is determined to be the failure of one main steam isolation valve (MSIV) with the availability of offsite power.

The analysis of containment minimum pressure is based on confirming the ECCS core reflood capability under the conservative set of assumptions that maximize the heat removal effectiveness of ESF systems, structural heat sinks, and other potential heat removal processes. These assumptions are discussed in Subsection 6.2.1.5.

6.2.1.1.2 Design Features

The design bases and design measures taken to assure that the containment structure is adequately protected against the dynamic effects of postulated missiles and pipe ruptures are discussed in Sections 3.5 and 3.6 respectively. The codes, standards, and guides applied in the design of the containment structure and internal structures are described in Section 3.8. Equipment environmental qualification is discussed in Section 3.11.

The accident analysis is based on Regulatory models such as those prescribed in the NRC's Standard Review Plan. Assumptions regarding safety injection and containment active heat removal devices have been incorporated into the analysis, within the standard methods for single failure assumptions. The containment is equipped with the following ESF equipment to mitigate the consequences of an inside containment break.

- Safety Injection
  - 4 safety injection tanks
  - 2 high pressure safety injection pumps
  - 2 low pressure safety injection pumps
- Primary Containment Cooling
  (Operational during Injection and Recirculation modes)
  - 4 containment fan coolers
  - 2 containment spray pumps
  - 2 shutdown cooling heat exchangers
- Secondary Containment Cooling
  - 2 Component Cooling Water loops
  - 2 CCW/ICW heat exchangers
  - 2 Intake Cooling Water loops

The accident analyses assume the most limiting combination of the above equipment both for offsite power available operation and for loss of offsite power. Both component and train failures are considered. For the updated LOCA analysis, the assumptions related to the CCW and ICW systems are selected to produce limiting results. For the LOCA event, both maximum and minimum safety injection are assumed with offsite power available and unavailable, respectively, for each break location. Maximum SI refers to the operation of two HPSI and two LPSI pumps with offsite power available. Minimum SI refers to the operation of one HPSI and one LPSI without offsite power. For each scenario, the loss of the limiting containment active cooling device (component or train) was assumed.

Following a LOCA, heat in the containment is rejected to the CCW by the air/water heat transfer in the containment fan coolers. The containment sprays take suction from the refueling water tank (RWT) and remove energy from the vapor space as the atomized spray water is heated. During the injection mode, the spray pump mini-recirculation line back to the RWT is open. Following the generation of the recirculation actuation signal (RAS), this line is isolated as the containment spray pumps take suction from the containment sump. While the generation of the RAS is based on a RWT low level trip, the LOCA analysis conservatively minimizes the amount of available RWT inventory. Following RAS, containment heat is rejected to the CCW via the water/water heat transfer in the shutdown cooling heat exchangers.

Other essential loads such as the HPSI pumps, containment spray pumps and control room A/C also transfer heat to the CCW. This heat is then transferred to the ultimate heat sink via the ICW heat exchanger. While not modeled in the containment P/T analysis, each of the two shield building ventilation system fan sub-systems is capable of removing the post-LOCA energy increase in the shield building annulus.

Two redundant containment vacuum breakers are provided for protection against loss of containment integrity under external loading conditions. Calculations of containment pressure following an inadvertent operation of the Containment Spray System results in pressures within the containment design differential allowable pressure. Details of this evaluation are provided in Subsection 6.2.1.1.3. The margin, between calculated and design pressure differentials is shown in Table 6.2-3.

The systems used for normal containment ventilation include the continuous Containment/Hydrogen Purge System and the Containment Cooling System. These systems are fully discussed in Section 9.4 and Subsection 6.2.2, respectively. No dependence is placed on the containment purge maintaining containment temperature and humidity. The limiting containment conditions for normal plant operation are contained in the Technical Specifications.

A containment sump is provided to collect water for the recirculation mode (refer to Subsection 6.2.2.2.3). All but approximately 2,100 gallons of the water drains to the containment sump following a LOCA or MSLB. This amount of water becomes trapped in the refueling canal since it lies below the level of the canal drains. The bottom of the containment sump is at elevation 7.58 feet MLW, which is below the lowest floor elevation inside containment except for the reactor vessel cavity and the reactor cavity sump.

6.2.1.1.3 Design Evaluation - Containment Pressure - Temperature Analysis

In the event of a postulated LOCA or MSLB inside containment, the release of coolant from the rupture area causes the high temperature, high pressure fluid to flash to steam. This release of mass and energy raises the temperature and pressure of the containment atmosphere. The

severity of the resulting temperature and pressure peaks developed depends upon the nature, locations, and size of the postulated rupture.

In order to establish the controlling rupture for containment design, a spectrum of primary and secondary breaks were analyzed as part of the design basis calculations to determine their significance in selecting the containment design basis accidents. Table 6.2-4 presents a summary of results (the calculated pressure, temperature, time peak pressure, time to end of blowdown, and total peak containment energy release) of these analyses and the containment design basis accidents are noted on Table 6.2-2. Note that Table 6.2-2 also provides peak CCW temperature.

The calculated transients following a postulated accident are a direct consequence of the energy balance within the containment. Of particular importance are the initial conditions postulated at the start of the accident, the ability of the heat sinks within the containment to absorb energy during the accident, and the capability of the Containment Heat Removal System to reduce the total energy within the containment thus bringing the containment heat sinks, sump water, and atmosphere into thermal equilibrium. The listing of initial conditions is found on Table 6.2-5.

The containment pressure analysis input data are based upon plant design features. A conservative prediction of consequences is assured by determining upper and lower bounding values of containment initial conditions, geometric parameters, and thermodynamic properties, and by applying these values in the manner producing maximum pressure and temperature results.

The containment accident analyses for MSLB are performed using an the Westinghouse SGNIII computer code. The SGNIII code is NRC approved to generate containment MSLB mass and energy release data. The SGNIII code is run concurrently with the CONTRANS containment code to produce the containment response to the MSLB. The CONTRANS code is described in the following section. In order to establish the controlling conditions for containment design, the accidents in Table 6.2-63B were analyzed for EPU.

Containment Pressure/Temperature Calculations

The containment pressure/temperature analyses are performed using the CONTRANS computer program (Reference 31). The CONTRANS model predicts the pressure and temperature within the containment regions and the temperatures in the containment structures. The code takes input from separate blowdown and core thermal behavior studies which have determined mass and energy input rates such as that from a Loss of Coolant Accident (LOCA) or Main Steam Line Break (MSLB).

The CONTRANS model analyzes both active and passive heat transfer within the containment following a LOCA or MSLB. The code can also be used for best estimate studies and has compared favorably with other industry codes such as CONTEMPT. The containment spray and fan cooler models as well as the passive heat sink numerical calculations enable an accurate calculation of their effect in reducing containment pressure and temperature.

CONTRANS calculates a pressure-time transient with stepwise integrations between the thermodynamic state points. The integrations are based on the laws of conservation of mass and energy together with their thermodynamic relationships. Superposition of heat input functions is assumed so that any combination of coolant release, metal-water reaction, decay

heat generation, and sensible heat release can be used with appropriate ESF features to determine the containment pressure time history associated with a LOCA.

The program uses a two region containment model consisting of the containment atmosphere (vapor region), the sump (liquid region), and a primary system model (reactor vessel) which is used to calculate mass and energy release data after the cold leg LOCA post-reflood period or the hot leg LOCA blowdown period. Mass and energy is transferred between the liquid and vapor regions by boiling, condensation, and evaporation. The heat and mass transfer coefficients between these two regions are calculated in CONTRANS. Each region is assumed to be homogeneous, but a temperature difference can exist between regions. Any moisture condensed in the vapor region during a time increment is assumed to fall immediately into the liquid region. Noncondensible gases are included in the vapor region.

The thermodynamic assumptions used in CONTRANS and the modeling of the atmosphere and sump regions, reactor vessel region (long term release), safety injection system, containment spray system and shutdown cooling heat exchanger are discussed in Reference (31). This also includes the modeling of the heat transfer surfaces and coefficients. The cooling medium, typically the component cooling water (CCW), utilized for the original shutdown cooling heat exchanger model is assumed to be at a fixed inlet temperature.

An upgrade effort of the CONTRANS code was undertaken to support the St. Lucie Units 1 & 2 LOCA containment analyses. The intent was to calculate a time dependent CCW temperature. The updated coding incorporated a CCW and Intake Cooling Water (ICW) or salt water loop with common CCW heat exchanger. The new model allows for the time dependent addition of extra heat loads and associated flows such as that of the safety injection or spray pumps or control room A/C. The model is conservative since loop transient time delays or water volumes are not credited and as such is simplistic in nature. The model has been directly attached to the existing CONTRANS code and allows for inputs such as ocean temperature and CCW heat exchanger performance parameters. The enhanced model also updates containment fan cooler capacity as a function of changing CCW temperature.

LOCA Analysis

A sensitivity study[1] was performed as part of the original design basis analyses varying free volume and the size of the heat sinks within the containment. The results show that the containment free volume is the principal factor responsible for large changes in the peak containment pressure and temperature responses. In the sensitivity study, the surface area of the heat sinks in the containment was varied over a range of ±20 percent. Two sets of analyses were done, one in which only the surface area of the internal heat sinks was varied and the other in which all heat sinks, including the size of the containment, were varied with a proportional change in the free volume. For the change of ±20 percent in the surface area of the internal heat sinks the peak pressure was found to vary by ±5 percent. For the change of all the heat sinks and a proportional variation of the free volume of about 25 percent, the peak pressure varied by about ±25 percent.

The sizing of the Containment Heat Removal System is based on the heat removal rate necessary to keep the peak pressure reached during a LOCA less than the design pressure of the containment. The peak pressure occurs during the blowdown phase. This peak is larger than the rise in containment pressure that occurs during the recirculation period when the containment energy balance is coming into equilibrium.

The CONTRANS model and formulations have been shown to be applicable and conservative for the design of the containment vessel by simulated design basis accident tests such as the CVTR (Ref. 32) blowdown experiment. As shown in the topical report of Reference (31), test cases are presented which outline the CONTRANS methodology. As shown, the proper representation of heat sinks is important, therefore care must be exercised in choosing the correct nodal spacing.

The containment heat sink and heat source data used in accident analyses are described in Tables 6.2-7 and 6.2-8. Table 6.2-7 is a detailed list of the geometry of each heat sink and Table 6.2-8 describes the resulting simplified heat sink models used for computer input. Node spacing used for concrete, steel, and steel-lined concrete heat sinks is fine enough to ensure an accurate representation of the thermal gradient in each slab.

The given values for surface area and thickness reflect the total areas and surface-area weighted thicknesses for all steel exposed to the containment atmosphere from all sources. These sources include structural steel, polar crane and removable platform structures, instrumentation and control equipment (cabinet, tubes, etc), hydrogen recombiners, HVAC equipment (ducts, fan coolers, valves), refueling machine, miscellaneous piping, and containment penetration nozzles, conduits and cable trays.

Steel is coated with a layer of primer and finish coat. All steel and concrete is assumed to be insulated on one side and in contact with the containment atmosphere (by a condensing heat transfer correlation) or sump on the other. The initial temperature is 120 F.

The given values of the concrete for surface area and thickness reflect total areas and surface-area weighted thicknesses of all concrete within the containment. This concrete includes the primary and secondary shield walls, pressurizer cubicle, regenerative heat exchanger cubicle, pipe tunnel, containment sump pump wall, and the steam generator foundation.

A complete list of the heat sink thermophysical properties used in the analysis is given on Table 6.2-8 and Section 6.1.2. The node spacing within a heat sink is dependent upon the gradient of temperature within the sink. To ensure an accurate representation of the temperature gradient, a maximum number of node points are placed where the temperature gradient is at a maximum. Too few node points simulate a more gradual slope implying excessive energy stored within the heat sink.

The high thermal conductivity and relative thinness of the steel heat sinks results in a rapidly uniform temperature distribution throughout the sink. It is, therefore, only necessary to provide for sufficient nodes to adequately define its relative thickness (in relation to other heat sinks).

Containment Peak Pressure/Temperature Analysis

Loss of Coolant Accident

Input Assumptions

A updated peak and long term containment pressure and temperature Loss of Coolant Accident (LOCA) analysis was conducted for the EPU. This analysis was a blend of past limiting assumptions coupled with more recent Standard Review Plan Regulatory requirements. This approach maintained conformance with the Licensing requirements of Unit 2. The following cases were analyzed:

- 9.82 ft² Double-Ended Suction Leg Slot Break
- 9.82 ft² Double-Ended Discharge Leg Slot Break
- 19.24 ft² Double-Ended Hot Leg Slot Break

For consistency with the design basis calculations, all cases were analyzed assuming minimum and maximum safety injection flows. The design basis break size sensitivity analyses were utilized in the selection of limiting break size for each break location.

The pressure and temperature transient calculations are based on the following potential sources of mass and energy release into the containment:

1. stored heat from the reactor core and internal structures
2. fission coastdown and decay heat from the reactor core
3. stored heat in the reactor coolant pressure boundary and the steam generators.
4. reactor coolant inventory with contained fission products
5. fission products from the fuel elements in the core
6. metal-water reaction
7. safety injection water
8. containment spray water

The above sources were addressed in the CEFLASH-4A, FLOOD3, and CONTRANS long term release models described earlier. Since reflood is not part of the hot leg break methodology the FLOOD3 code was not used for the hot leg breaks. The mass and energy release calculation was therefore limited to the CEFLASH-4A and CONTRANS long term release models. For the cold leg breaks, the FLOOD3 mass and energy release was a continuation of the CEFLASH-4A blowdown. All mass and energy was input to the CONTRANS code for the transient calculation of containment pressure and temperature.

The containment related assumptions are as follows:

1. The containment free volume is 2,499,735 ft³.
2. The initial relative humidity within the containment is 45 percent.
3. The initial containment pressure is 15.41 psia.
4. The initial containment, sump, and heat sink temperature is 120 °F, the maximum Tech. Spec. operating temperature of the containment.
5. No leakage into or out of the containment occurs.

6. A heat transfer coefficient as a function of ΔT is assumed for the transfer of heat to the annulus. The expression as presented in Reference (31) is:

$$h = 0.2\ \Delta T^{1/3} \qquad \text{(Btu/hr-ft}^2\text{-°F)}.$$

7. No heat transfer to the sump, shield wall, or atmosphere is assumed.

8. The decay heat after reactor shutdown is calculated on the basis of infinite reactor operation at 3030 MWt (3020 MWt with 0.3% power measurement uncertainty).

9. For cold leg breaks, all energy is assumed to go out the break. For hot leg breaks all core and reactor vessel energy is assumed to go out the break. RCS and SG wall sensible heat loss is assumed to be insignificant relative to the long term release energy addition.

10. One containment spray pump operates and sprays a base flowrate of 2700 gpm of 104 °F (max. Tech. Spec. Temperature plus instrument inaccuracy) water into the containment until the recirculation actuation signal is generated. Following the closure of the mini-recirculation valves to the RWST after RAS, an additional 150 gpm is assumed.

11. Although the Tech. Spec. minimum Refueling Water Storage Tank (RWST) volume is 477,360 gallons, the volume remaining in the tank following RAS, the time associated with switching to the sump, and NPSH requirements for the safety injection and containment spray pumps must be considered. With these considerations, the design basis switch-over volume of 290,300 gallons was assumed for safety analysis to calculate time of RAS.

12. One shutdown cooling heat exchanger (SDCHX) operates during the recirculation mode to cool the containment spray water when one train of containment spray is running and two SDCHXs operate when both spray trains are running. A "service" U value of 274 Btu/hr-ft²-°F is assumed. The heat removal capacity is updated as a function of time by a changing CCW temperature.

13. The base fan cooler performance is consistent with the original design basis capacity as shown in Table 6.2-6.

14. The analyses are conducted assuming loss of offsite power. For the minimum SI cases, the loss of diesel generator results in the loss of one train of containment cooling which disables one containment spray and one train (i.e. two units) of fan coolers. The maximum SI cases require flow from both trains of safety injection. The maximum SI cases must assume both emergency diesel generators start. The failures for these cases are assumed to affect one spray train or one fan cooler train. The maximum SI cases are run twice for each break location. One case assumes the failure of one spray train while the other case assumes a failure of one fan cooler train. The minimum SI cases only require flow from one safety injection train. The assumed failure is the loss of a diesel generator and only one train of containment spray and one fan cooler train are assumed for the minimum SI cases.

15. A fan cooler containment high pressure actuation setpoint of 5.15 psig and a spray containment high high actuation setpoint of 7.05 psig were assumed. These analytical setpoints included allowance for instrument uncertainty and delay times.

The LOCA accident analyses are based upon the following additional overall assumptions:

1. Reactor thermal power is 3030 MWt (normal operation at 3020 MWt plus 0.3% power measurement uncertainty).

2. An initial T_{cold} of 551°F (plus 3°F for instrument uncertainty).

3. An initial RCS flowrate of 375,000 gpm.

4. For the discharge leg break, the contents of three safety injection tanks (SITs) discharge into the reactor vessel when reactor coolant system pressure drops below tank pressure. This assumes the entire contents of the safety injection tank in the ruptured leg does not reach the core. For the hot and suction leg cases the contents of four SITs is considered.

5. An average of the min/max Technical Specification SIT water volume per tank of 1488 ft^3 was assumed with a Technical Specification maximum initial cover gas pressure of 650 psig.

6. One high and low pressure safety injection pump are assumed during the injection mode for the minimum SI cases, while 2 HPSI and 2 LPSI pumps are assumed for the maximum SI cases. Following RAS, all LPSI pumps are shut off.

7. A CCW flowrate of 3719 gpm is assumed for one Shutdown Cooling Heat Exchanger.

8. A degraded ICW flowrate of 13,857 gpm is assumed with a maximum ocean temperature of 95°F for the LOCA containment pressure and temperature analysis. For the CCW temperature analysis, see Section 9.2.1.2.

9. The CCW heat exchanger performance for the peak pressure and temperature analyses is done with a U factor of 274 Btu/hr-ft^2-°F. The CCW analysis uses a U factor of 300 Mtu/hr-ft^2-°F.

10. The addition of HPSI pump, containment spray pump and control room A/C heat load was included in the CCW calculations.

11. Volumetric expansion due to primary and secondary conditions at hot full power operating conditions vs. "cold drawing" values was considered per SRP guidelines. This includes the components of pressure, temperature, and manufacturing tolerance uncertainties.

12. Initial normal pressurizer and steam generator water levels were assumed.

13. Bounding fuels related inputs were assumed in the blowdown analysis.

14. The LOCA containment pressure and temperature, and CCW temperature analyses are performed with no steam generator tube plugging (SGTP). This maximizes heat transfer from the secondary to primary system.

LOCA Analysis

As described earlier, the LOCA containment analysis is a multi-phase effort requiring the use of three different codes. The event is characterized by distinct phases which are a function of break location. For all break locations, there is an initial blowdown phase which is typically a 10 to 25 second interval and was analyzed with the CEFLASH-4A code. The outputs produced by the CEFLASH-4A code were the mass and energy release data for the interval and the RCS and steam generator conditions at the end of blowdown. For the suction and discharge cold leg breaks, the next phase is the reflood phase followed by the post-reflood phase. This was performed by the FLOOD3 code which used the end of blowdown conditions as a starting point for continuing the event. The primary purpose of the reflood and post-reflood periods is to account for the steam generator inventory energy, as well as the RCS and steam generator metal energy, all of which contribute to the exiting steam flow.

The product of the FLOOD3 code is similar to that of CEFLASH-4A in that mass and energy release data is generated and system conditions at the end of post-reflood are used as a starting point to the long term energy release model of the CONTRANS code. The CONTRANS code is used to produce the containment pressure / temperature response. As such the mass and energy release data produced by CEFLASH-4A and FLOOD3 are input to CONTRANS. As mentioned in the code section, 50% of the mass and energy release is subtracted from the FLOOD3 output during the time that the annulus is full to the point that the safety injection tanks are empty. During the long term phase of the event, CONTRANS also produces the mass and energy release data due to decay heat, residual metal energy from the RCS loops, reactor vessel, and steam generators. The steam generator inventory also heats up the exiting steam flow to the secondary temperature prior to release to containment.

For the hot leg break, the greatest quantity of two-phase mass which leaves the top of the core bypasses the steam generators and discharges directly into the containment. Since there is no mechanism for adding significant quantities of the steam generator secondary side fluid energy or RCS metal other than that of the reactor vessel to the break flow stream, the reflood and post-reflood analysis is not conducted for hot leg breaks. Therefore, reactor vessel temperature and heat loss conditions at the end of blowdown are directly input to the CONTRANS long term boiloff model.

The CONTRANS run is the final analytical phase of the analysis. As an input to the CONTRANS run, the Recirculation Actuation Signal (RAS) is required. As described in the assumptions section, this is a function of the amount of available RWST inventory compared with the assumed safety injection and containment spray flow rates. It is conservative to use the minimum spray flow rate for peak pressure and temperature analyses.

The critical time dependent parameters of containment pressure and temperature and, most recently, CCW temperature were the measure used to conclude that the analysis is acceptable.

LOCA Results

A summary of the containment peak pressure and temperature and peak CCW temperature results are provided in Table 6.2-2. Note that this is an overall summary table which compares

the original design basis calculations with the updated analysis. Also listed are the relevant pressure and temperature criteria which were followed in the analysis. As can be seen from the summary table, the peak pressure and temperature from the updated analysis to support EPU were from the Double-Ended Hot Leg Slot break minimum SI case. The peak CCW temperature was from the Double-Ended Suction Leg break minimum SI case. Plots of the limiting peak containment pressure and temperature are provided in Figures 6.2-2a through 6.2-3a. As can be seen, the limiting containment pressure and temperature cases are characterized by the peak right after the blowdown phase of the LOCA event. The small bump further into the transient represents the switch-over to the recirculation mode when relatively hot containment spray water is introduced to the containment.

Each case was shown to meet the peak containment pressure and CCW temperature criteria. The peak containment pressure and temperature cases fell below the original design basis analysis results largely due to improved methods and enhanced computer codes. All the cases analyzed to support the EPU were also shown to meet the SRP Section 6.2.1.3 criteria to demonstrate containment pressure reduced to less than half the peak calculated value by 24 hours.

Main Steam Line Breaks

Analyses are performed to show that the containment design pressure is not exceeded even if the following single active failures are postulated: (1) loss of one containment heat removal train (i.e., two fan coolers and one spray pump); or (2) MSIV failure to close; or (3) main feedwater isolation valve (MFIV) failure to close. The assumptions for each case are discussed more fully in Subsection 6.2.1.4.2.

The peak containment pressure is calculated to occur following the DBA 0.0 percent power MSLB with the failure of one of the trains of the Containment Heat Removal Systems with offsite power available. The peak containment temperature is calculated following the DBA 100.3 percent power with the failure of one MSIV assuming the availability of offsite power. The containment pressure and temperature transients for the most severe MSLB pressure and temperature cases are shown on Figures 6.2-9 through 6.2-12. Figures 6.2-11a and 6.2-12a show the long term pressure and temperature history of the containment temperature DBA. Figures 6.2-12 also shows the calculated transient containment vessel surface temperature for the containment temperature DBA. Pipe break locations, break areas, peak pressures and temperatures, times of peak pressure, initial power level, single active failure assumed and total energy released to the containment are summarized in Table 6.2-4 for each MSLB analyzed. The DBAs are identified in Table 6.2-2.

The heat transfer coefficient used for LOCA analyses initiates with Tagami and exponentially decreases to Uchida. The Uchida heat transfer coefficient contained in the SGNIII version of CONTRANS computer code is used for the analysis of all secondary system breaks.

The containment analyses for the MSLBs are performed using all the containment initial conditions, heat sinks and methodology assumed for the LOCA analyses except for the following:

a. For the MSIV and MFIV failure cases, two containment spray pumps operate and spray 5,400 gpm of water at 104°F into the containment.

b. Since the most severe MSLB containment transients are developed assuming the availability of offsite power, the containment sprays are assumed to reach full containment spray flow at 59.65 seconds after the containment pressure is calculated to reach the containment spray actuation signal (CSAS) analysis setpoint.

c. Consistent with the MSLB single active failure assumptions, four containment fan coolers and two containment spray pumps operate for the MSIV and MFIV failure cases. For the Containment Heat Removal System train failure case, two containment fan coolers and one containment spray pump are assumed to operate.

d. Consistent with the assumption of availability of offsite power, the containment fan coolers are assumed to be in full operation 11.15 seconds after the containment is calculated to reach the safety injection actuation signal (SIAS) analysis setpoint.

e. The vapor-sump heat and mass transfers are conservatively omitted for all MSLB analyses.

For all MSLBs analyzed, following blowdown of the ruptured steam generator unit, the RCS decay heat is transferred to the intact unit which, in turn, vents to the atmosphere when its main steam safety relief valves open. Therefore, there is no physical mechanism for the release of significant amounts of mass or energy to the containment after the end of blowdown. Main feedwater line breaks (MFWLB) are not analyzed since such breaks result in a blowdown less limiting than the MSLB because the pipe break mass flow for the MFWLB is limited by the feedwater line size. Fluid enthalpy for the MFWLB is also less than the enthalpy of the fluid in the MSLB.

A discussion of the computer codes, and the assumptions, including all assumed single active failures, used in deriving the MSLB mass and energy releases are discussed in Subsection 6.2.1.4. Accident chronologies for the most severe secondary system breaks are provided in Table 6.2-9. It is assumed that time equals zero at the start of the accident. The mass and energy release data is provided in Tables 6.2-12F and 6.2-12G.

The instrumentation provided to monitor and record the post-accident containment pressure and temperature, and the containment sump temperature is discussed in Subsection 7.5.1.8. This instrumentation is designed and qualified for the safe shutdown earthquake and the environmental conditions discussed in Sections 3.10 and 3.11.

For Cycle 2, the main steam line break (MSLB) analyses were performed to assure the identification of the most severe cases for Containment Analysis. Since the steam generator feedwater ring is below the initial steam generator water level, feedwater break cases will result in liquid entrainment for all but the most trivial break sizes. For this reason, feedwater line break cases are always less severe than steam line breaks at the same power level and a spectrum of feedwater line break cases is not required.

For the EPU (MSLB), a complete peak pressure analysis was done. In order to confirm that the most severe case is identified, the three single failure events were analyzed at 0%, 25%, 50%, 75%, and 100.3% power levels. The peak pressure case that results in the maximum peak

temperature was run as an EQ case to provide the maximum containment temperature. The EQ case was rerun to identify the containment liner temperature.

Following a postulated MSLB main steam isolation and main feedwater isolation are initiated simultaneously by a MSIS from the Engineered Safety Features Actuation System. Feedwater flow is automatically terminated by the main feedwater isolation valves (MFIVs) or MFIV backup valves after receipt of a MSIS. The main steam isolation valves also close upon a MSIS.Table 6.2-65 provides the valve closure times and the assumptions used for the main steam line break analysis.

The feedwater hammer analysis was reviewed for the stretch power operation to demonstrate that the original analysis performed for the 100 percent power operation is conservative for the stretch power level as well.

Analyses have been performed to show that the containment design pressure is not exceeded even if the following single active failures are postulated: (1) loss of one containment heat removal train (i.e., two fan coolers and one spray pump); (2) MSIV failure to close; (3) MFIV failure to close. The specific assumptions for each case are given below:

Case 1 - Loss of One Containment Heat Removal Train

Since postulation of a steam line break plus the loss of one containment heat removal train assumes a single failure (e.g., loss of one diesel generator set), the MSIVs and MFIVs are postulated to function for this case. The main steam inventory in the line between the faulted steam generator nozzle and the nearest MSIV expands into the containment. The feedwater inventory between the faulted steam generator and its MFIV is assumed to flow into the steam generator where it is released to the containment. One containment spray train and two containment fan coolers are assumed to operate.

Case 2 - MSIV Failure

A single failure of one MSIV during a postulated main steam line break accident does not cause uncontrolled blowdown of more than one steam generator. The MSIV failure is postulated to occur at the faulted steam generator. Closure of the operational MSIV provides isolation of the intact steam generator. The MFIVs and both containment heat removal trains (two containment sprays and four containment fan coolers) function for this case. The steam inventory from the faulted steam generator up to the closed MSIV on the intact steam generator expands into the containment. The feedwater inventory between the faulted steam generator and its MFIV is assumed to flow into the steam generator and is released to the containment.

Case 3 - MFIV Failure

A single failure of one MFIV during a postulated main steam line break accident is accommodated by closure of the backup feedwater isolation valves upon receipt of a MSIS. The MSIVs and both containment heat removal trains (two containment sprays and four containment fan coolers) are postulated to operate. The MFIV nearest to the faulted steam generator is postulated to fail. Steam in the steam line between the break and the nearest MSIV expands to the containment. The feedwater inventory between the faulted steam generator and the feedwater backup valve flashes into the affected steam generator.

The feedwater flow rate to the faulted steam generator is determined using the calculated faulted and intact steam generator pressure responses, the feedwater pump characteristics and the feedwater isolation or regulating valve flow coefficients.

Containment External Pressure Analysis

Protection of the containment vessel against excessive external pressure is provided by two independent vacuum relief lines each sized to prevent the differential pressure between the containment and the Shield Building atmosphere from exceeding the design value of 1.05 psi. The vacuum system conforms to the requirements of para. NE-7116 of ASME Section III. EC280084

Each vacuum relief assembly consists of a check valve inside and an automatic air-operator butterfly valve outside the containment vessel. Actuation of the butterfly valve is controlled by differential pressure between the Shield Building annulus and the containment atmosphere. Redundant transmitters sense the differential pressure and provide a signal to the pilot solenoid on the air-operated butterfly valve to open. The butterfly valves which perform both a containment isolation function (closed) and vacuum relief function (open), will fail closed on loss of air. They are provided with accumulators which provide a minimum of three operations of the valve for vacuum relief in the event of loss of instrument air. The accumulator and piping for operation of the valves are designed as seismic Category I. Each accumulator is provided with test connections which allow testing of the accumulator and its associated check valves. Containment vacuum relief is also discussed in Subsection 3.8.2.3. The control diagram for the containment vacuum relief valves is shown on Figure 9.4-9. The P & I diagram for the instrument air connections to the vacuum relief valves is shown on Figure 9.3-2.

An analysis is made of the design basis accident for a containment differential pressure which is an actuation of the Containment Heat Removal System during normal plant operation The containment external pressure analysis was performed using the GOTHIC computer code.

The evaluation of the effects of the inadvertent containment cooling actuation was performed using GOTHIC, Version 7.2b (QA). GOTHIC (Generation of Thermal-Hydraulic Information for Containments) is a general purpose thermal-hydraulic computer program for design, licensing, safety and operating analysis of nuclear power plant containments and other confinement buildings. Applications may include pressure and temperature determination, equipment qualification profiles, inadvertent system initiation, and degradation or failure of engineered safety features. Numerical Applications has stated in Release Report NAI-1688-001, Application of GOTHIC for Subatmospheric conditions: EC280084

GOTHIC has been used extensively for containment pressurization, including the effects of:

- Steam and water injection
- Sensible heat transfer to walls and structures
- Condensation on walls and structures
- Non condensing gas effects on condensation suppression
- Spray cooling and condensation

These are the same controlling phenomena in an inadvertent spray activation event leading to subatmospheric containment pressures. There is a large validation basis for the pressurization analysis as described in the GOTHIC Qualification Report. That reference does not include direct validation for depressurization events. However, the governing equations, fluid properties and correlations built into the GOTHIC are general and do not depend on the pressure being at or above 1 atmosphere. EC280084

Assumptions used in the analysis of an inadvertent Containment Heat Removal System actuation are listed in Table 6.2-11.

The results of two bounding cases are as follows: EC280084

Case	Containment RH%	Annulus Temp.	Max. Cont. Diff. Pressure (PSI)	Max. Shield Bldg. Diff Pressure (PSI)
1	40	56	1.00	1.67
2	100	110	0.65	2.45

The containment and Shield Building external pressure and design values and margin are given in Table 6.2-3.

There is no single failure spurious signal which can initiate both containment spray trains. Initiation of both containment spray subsystems is by coincidence of safety injection actuation signal and high-high containment pressure signal which indicates that a major energy source has been introduced into containment and that humidity is rapidly approaching 100 percent.

Main Steam Line Breaks Results (Cycle 2)

The peak containment pressure for stretch power was calculated to occur following a MSLB at 102 percent power with a failure of one MSIV assuming increased core inlet temperature and offsite power available. The peak containment temperature occurred following a MSLB at 102 percent power with the failure of either one train of the Containment Heat Removal System or one MSIV assuming increased core inlet temperature, decreased RCS flow and offsite power available. The mass and energy released to the containment are summarized in Tables 6.2-67A through F.

For all MSLBs analyzed, following blowdown of the ruptured steam generator unit, the RCS decay heat is transferred to the intact steam generator which, in turn, vents to the atmosphere when its main steam safety relief valves open. Therefore, there is no physical mechanism for the release of significant amounts of mass or energy to the containment after the end of blowdown.

The peak containment pressure/temperature was calculated to occur following a MSLB at 102 percent power and proven to be below the design conditions.

MSLB - Evaluation for Increased Steam Generator Tube Plugging and Reduced RCS Flow Rate

The most limiting mass and energy releases for an inside containment MSLB are generated assuming there are no steam generator tubes plugged and using the maximum Reactor Coolant System (RCS) flow rate. Since mass and energy release data generated for EPU are based on more conservative inputs (maximum RCS flow, no SGTP), the EPU mass and energy release data would bound those with the increased SGTP and reduced RCS flow rate.

6.2.1.2 Containment Subcompartments

6.2.1.2.1 Design Bases

Subcompartment pressurization due to RCS hot and cold leg pipe breaks was considered in the original containment structure design. Since then, however, the NRC revised General Design Criterion (GDC) 4 to eliminate the consideration of dynamic effects of a loss of coolant accident from the plant design bases. The dynamic effects of a LOCA include the effects of missiles, pipe whipping, discharging fluid (i.e., jet impingement), decompression waves within the ruptured pipe and dynamic or nonstatic pressurization in cavities, compartments, and subcompartments. The pipe rupture criteria used in the original (and latter) design are described below. The mechanical/structural loading effects or compartment pressurization from a circumferential (guillotine) or longitudinal (slot) break in the RCS hot or cold legs are no longer considered a design basis (References 28 and 29). The environmental qualification design basis for safety related equipment inside containment remains unchanged (Reference 27).

The existing analysis postulates high energy pipe ruptures in the annular area between the reactor vessel and the primary shield wall (called the reactor cavity), and the enclosed volume below the operating floor bounded by the primary and secondary shield walls (called the secondary shield wall area). This latter region contains the reactor coolant pumps and steam generators. The pressurizer area is analyzed separately for the pressure transient and uplift force.

Analyses are performed to determine the maximum pressure which could be produced by a broken high energy line discharging mass and energy into the subcompartments. Vent area is provided within each subcompartment to mitigate the effects of high energy line breaks.

Calculated DBA differential pressures are compared to the design differential pressure values used in the structural design of subcompartment walls and supports to insure that calculated values are less than design values.

Breaks are chosen for the analysis based upon the maximum break size that could be postulated given the structural stiffness characteristics of the Reactor Coolant System and its supports and pipe restraints. Restraints in the primary shield wall pipe penetrations help limit the size of breaks in the reactor cavity.

Table 6.2-13 is a summary of postulated pipe ruptures for the containment subcompartment analysis. Contained in this table is the pipe break location, description of the break, break area and release rate data and table numbers. The last column in this table, "Release Rate Data Table Numbers," refers to, for each compartment, a table of blowdown mass flow rate and energy release rates as a function of time for the break which was used for the component support evaluation.

Pipe break locations were chosen based upon the high stress point criteria in accordance with Regulatory Guide 1.46 (R0) and SRP 3.6.2, Refer to Subsection 3.6.2).

The peak loads tabulated from each of the pipe breaks listed on Table 6.2-13 was applied to the corresponding structure. In all cases it has been found that the structural design was adequate to withstand the differential forces resulting from the break. Table 6.2-3 provides a comparison between the peak calculated force and the structural design.

The major components of the RCS are designed to withstand the forces associated with the design basis pipe breaks. These pipe thrust forces at the break location, resultant subcompartment differential pressurization-forces and internal asymmetric hydraulic forces acting in the reactor internals. A complete description of the evaluation of the plant faulted condition for these components is provided in Subsection 3.6.2.

6.2.1.2.2 Design Features

The first two paragraphs of this section describe the vent paths that were modeled in the reactor cavity pressurization analysis that was performed for the plant operating License. The description of these vent paths is retained in the UFSAR for historical purposes only. Reactor cavity pressurization is no longer a design basis for the plant.

The reactor cavity is the annular air space between the primary shield wall, a heavily reinforced concrete structure, and the reactor vessel. This region contains the reactor vessel horizontal and vertical supports, located beneath the Reactor Coolant System piping. The major pressure relief paths for the cavity above the piping are the annular space between the reactor vessel flange and the primary shield wall at elevation 36 feet, and the annular spaces between the six primary shield wall pipe penetrations and the hot and discharge legs. In the lower cavity pressure relief is provided by the sump tunnel and the two tunnels leading to the electrical tunnel. These two tunnels are provided with pressure relief dampers as described in Subsection 6.2.1.2.3. All tunnels vent to the secondary shield wall area. Figures 6.2-18 to 21 show the details of the reactor cavity area.

Above elevation 36 feet a neutron shield wall obstructs flow into the refueling pool. About 180 ft^2 of vent area is provided from this enclosed region to the upper containment at the missile shield. See Figure 6.2-19 for details of this area.

The steam generator and pressurizer are enclosed by heavily reinforced concrete shield walls in a single large compartment below elevation 62 feet. See Figures 6.2-18 to 21 for details of the arrangement of subcompartments in this region. Pressure relief is provided by openings in the secondary shield wall to the annular areas between the secondary shield wall and the containment, and by flow through the operating floor where the steam generators pass through the floor to the upper containment.

The lower pressurizer and surge line piping are open to this region and venting is to an upper enclosed volume above elevation 62 feet. Pressure relief in this upper volume is provided by a doorway at the floor level.

Subcompartment free volumes and vent area information is discussed in Subsection 6.2.1.2.3.

6.2.1.2.3 Design Evaluation

The following description documents the reactor cavity pressurization analysis that was performed for the plant Operating License. It is retained in the UFSAR for historical purposes only (for example Tables 6.2-26 and 27). Reactor cavity pressurization is no longer a design basis for the plant.

The modified CEFLASH4 computer code was used to calculate the mass and energy release rates from postulated Reactor Coolant System pipe ruptures. This code is the same as the one

containing the combination Henry-Fauske/Moody critical flow subroutine, described in Subsection 6.2.1.1.5 of the Arkansas Nuclear One Unit Two FSAR (Docket No. 50-368).

The "modified CEFLASH-4" code is, different from the CEFLASH-4A code used in the approved CESSAR PSAR. However, the "modified CEFLASH-4" code produces the same mass and energy releases as the CEFLASH-4A code.

The difference between CEFLASH-4A and CEFLASH-4 (not modified) is discussed in CESSAR-PSAR. In the "modified CEFLASH-4" there is the same method for calculation of critical mass flux as there is in CEFLASH-4A. For this reason, CEFLASH-4A and "modified CEFLASH-4" produce the same blowdown release rates.

The "modified CEFLASH-4" code was used because input data were available which satisfied input requirements of that version of the code. CEFLASH-4A input has a different format and would have required re-working the input data which would have been time consuming, while the blowdown release rates would not be changed.

The "modified CEFLASH-4" code was used for the Arkansas Power and Light Unit One-2 FSAR, which has been reviewed and approved by the NRC.

The subcompartment pressurization effects are dependent on the blowdown energy release rates. In order to provide adequate conservatism for design evaluation, the following methodology is used to generate short duration mass and energy release rates.

a. Subcooled and low quality break flow are computed using the Henry - Fauske correlation with a discharge coefficient of 1.0.

b. Break flow with quality above approximately 6.0 percent is computed using the Moody critical flow correlation with a discharge coefficient of 1.0.

c. The momentum flux terms are omitted when solving the conservation of momentum equation for flows within the Reactor Coolant System.

d. Initial Reactor Coolant System conditions are at 102 percent of nominal full power conditions.

e. Reactor Coolant System volumes are increased over nominal values.

f. The pressurizer water level is assumed to be above the normal full power operating water level.

The method used to calculate the mass and energy releases is similar to the one described in Subsection 6.2.1.1.4 of CESSAR (approved December, 1975).

The mass and energy release data that was utilized for the structural design is identical to that used for component support design verification. Therefore, the peak and transient forces provided in Figures 6.2-23 thru 6.2-30 were utilized for both the structural and component design, where applicable. The analysis of the RCS components (i.e., Reactor Vessel, Steam Generator, RC Pumps, Pressurizer and RC Piping) due to the asymmetric pressure loadings is provided in revised Subsection 3.9.1.4.1. A tabulation of results and comparison with the appropriate allowables is also provided. (See Subsection 3.9.1.4.1)

The component and support loads for the Steam Generator, Reactor Coolant Pump, and Pressurizer were determined by equivalent static analyses. A load factor of two on the calculated thrust, jet impingement, and subcompartment pressure loads is employed to account for the dynamic response of the structure. The model employed for static analysis is shown on Figure 3.9-18.

Table 6.2-13 provides a summary of the Reactor Coolant System postulated pipe ruptures. The mass/energy release rates of all ruptures are given in Tables 6.2-14A to 23B.

Since a portion of the main steam lines runs inside the secondary shield wall, the effects of a double ended guillotine rupture of the steam line are analyzed. The break is taken at node 16 of the line, as discussed in Appendix 3.6E and is shown on Figure 3.6E-1. The blowdown data used in the subcompartment analysis is derived from the RELAP 3[(3)] code used to generate the hydrodynamic forces. The assumptions and options used are the same as those used for the RELAP-4 computer code discussed below. Table 6.2-24 shows the mass/energy release rates as a function of time.

Analyses of the pressure transients in all the subcompartments are performed using the RELAP-4 Mod 5[(4)] computer code. The program options used in these studies are:

a. The RELAP-4 - CONTAINMENT option;

b. The thermal homogeneous equilibrium model (HEM) for determining the critical flow for air- steam-water mixtures;

c. The incompressible single stream form of the momentum equation, as these break cases produce relatively low subcompartment pressures, even within the break node.

The junction effective inertia (l/A) is calculated in a manner consistent with the methods described in RELAP-4. For a pair of volume v_i and v_k, with cross-sectional areas, A_i and A_k, and lengths in the direction of flow, l_i, and l_k and a junction with area A_j and length l_j where $A_j \neq A_i$, A_k and $l_j << l_i$, l_k, the inertia coefficient l/A is computed as:

$$\frac{l}{A} = \frac{l_i}{2A_i} + \frac{l_j}{A_j} + \frac{l_k}{2A_k} \qquad (1)$$

Flow coefficients for the subcompartment analysis are computed in a manner also consistent with the calculations done by the RELAP-4 code. The junction friction coefficient utilized in the analyses is a combination of the wall friction losses (K_F), and any irreversible friction losses (K_T) such as area changes, turns and gratings. The wall friction loss is computed as:

$$K_f = K_{f_i} + K_{f_j} + K_{f_k} \ , \qquad (2)$$

$$K_{f_i} = \frac{fl_i}{2D_{H_i}} \left(\frac{A_j}{A_i}\right)^2 \qquad (3)$$

$$K_{fj} = \frac{fl_j}{D_{HJ}} \qquad (4)$$

$$K_{fk} = \frac{fl_k}{2\,D_{Hk}} \left(\frac{A_j}{A_k}\right)^2 \tag{5}$$

Where D_{Hn} are the hydraulic diameters of the system of volumes i and k and junction j and f is conservatively assumed to be proportional to D_H - 1/4 (see References 5 and 6). This gives values of order 0.01. The coefficient for the total friction loss at a junction, K_{RELAP}, is then given by

$$K_{RELAP} = K_F + K_T \left(\frac{A_j}{A_T}\right)^2$$

where A_T represents the reference area to which K_T applies.

All subcompartments are assumed to be initially entirely filled with air, with no liquid present and with temperature, pressure and humidity conditions consistent with those used in the containment analysis (Table 6.2-5).

The conservatism of these conditions in maximizing the pressure is discussed in connection with the containment analysis.

For the Stretch Power Analysis, the mass and energy release data have been analyzed on Tables 6.2-66A through F. There is only a minor increase as compared to the original data provided for the same breaks at 2560 MWt.

For a similar mass and energy release increase, the containment peak pressure calculated for the Stretch Power resulted only in a minor rise (≤ .5 percent).

Taking into account the identical methodology used for calculating the containment peak pressure and the subcompartment loading, and also considering the existing design margins ≥ 100 percent) of the containment subcompartments (Table 6.2-2), it is concluded that for the Stretch Power, the subcompartment loads are below the design values.

Subcompartment Modeling

Divisions between subcompartments are determined by the physical flow restrictions within each compartment. A flow restriction is defined by the presence of an object in the flow path that changes the flow area in that direction, with the subdivision defined at the point of minimum flow area. This minimum flow area becomes the junction flow area used in the RELAP 4 analysis. For the models constructed for the reactor cavity and secondary shield wall area flow restrictions included the presence of steel and concrete supports, doorways, vent shafts and gratings, as well as large equipment such as the reactor vessel, primary piping, the steam generator, reactor coolant pumps and the pressurizer. By choosing node boundaries at the various physical flow restrictions, a method consistent with the lumped-parameter calculation model used by RELAP 4 and described above, calculated differential pressures and consequent support loads are realistically maximized. The nodalization sensitivity study performed for the Shearon Harris PSAR (Docket 50-400, 401, 402 and 403) shows that the peak calculated differential pressure is very sensitive to an increasing number of nodes until that number equals the number defined by physical flow restrictions. Increasing the subdivision of nodes beyond this point does not result in increased pressure differentials. The study concludes that further

arbitrary subdivision of the compartment is unwarranted and can lead to unrealistic results if these "fictitious junctions" are modeled. The subcompartment models discussed below take account of all physical flow restrictions present in a manner identical to that shown to be optimum by the sensitivity study.

Table 6.2-25 list the results of the subcompartment analysis. In this table the peak node pressure, and peak differential pressure are listed. Along with these values a figure is referenced for both those values. Refer to Table 6.2-25 for a discussion on the peak and transient loading on the major components used to establish the adequacy of the support design.

The analysis performed for the major components support does not differ from the structural analysis model.

a. Reactor cavity

   Due to the application of the leak-before-break criteria, the reactor cavity pressurization from the pipe breaks is not longer a design basis for the plant. The following discussion with associated tables and figures is retained only for historical purposes.

   Pressure relief dampers were originally installed between the reactor cavity and the electrical tunnel to vent mass and energy released to the cavity area from RCS pipe breaks in the annular space between the reactor vessel and the primary shield wall. The safety related vent function, however, has since been eliminated from the damper design basis (via the 50.59 process) by taking credit for the leak-before-break qualities of the RCS main loop piping. The following paragraph documents performance characteristics of the dampers that were modeled in the reactor cavity pressurization analysis.

   The reactor cavity model is shown on Figures 6.2-23 and 24. Volumes are defined by the reactor vessel flange (elevation 36 ft), the hot and discharge legs, the reactor vessel supports, the reactor vessel tangent line, and the pipe penetrations and tunnels. Tables 6.2-26 and 27 provides the various data values and flow coefficients used in the analysis. The relief dampers within the passageways leading to the electrical tunnel (junction 74 and 75) are assumed to open at a pressure differential of 1.1 psid with a 0.2 second delay, with a linear slope from closed to fully open by 0.0574 seconds after the delay. These performance data are the results of analyses performed by the damper manufacturer. Insulation on the reactor and piping is assumed to remain in place and is included in the calculation of occupied volume and obstructed flow area.

   The breaks are assumed to occur in volumes above the reactor vessel horizontal supports (volume 2, discharge leg break and volume 4, hot leg break). The 200 square inch discharge leg guillotine break produces the highest pressures of the limited-area breaks. See Figures 6.2-25a to 25m, for the pressure response history for this break. Table 6.23 compares the pressures for the current set of breaks with the design pressures for the reactor cavity walls.

b. Secondary Shield Wall

Secondary shield wall area models are defined on Figures 6.2-26 and 27. Volumes are defined by the suction and discharge legs of the reactor coolant pump, the steam generator diameter, the shield walls and the operating floor. Tables 6.2-28 and 29 list the various data values and flow coefficients used in the analyses. Volume and flow areas are calculated conservatively from the "as built" design and take account of all major equipment and support structures. No flow is assumed to enter the reactor cavity to maximize the pressures.

The breaks analyzed are listed in Table 6.2-13. The 1400 square inch suction leg guillotine break at the steam generator nozzle (which has been eliminated by the application of the LBB criteria), represents the bounding mass and energy release into the compartment for all postulated RCS pipe breaks within the compartment. The mass and energy release at extended power uprate conditions resulting from all other smaller postulated RCS pipe breaks remains bounded by the mass and energy release utilized for the original 1400 square inch suction leg rupture. Thus the differential pressure across the secondary shield wall structure at extended power uprate conditions is bounded by original design basis. The following discussion with some of the associated tables and figures is retained only for historical purposes. For Reactor Coolant System breaks, flow is directed into the region between the steam generator and the primary shield wall (volume 1) away from the pressurizer volumes. This maximized the differential pressure across the Reactor Coolant System. Flow from suction and discharge leg breaks is also directed into the region between the steam generator and the secondary shield wall (volume 2) to find the maximum possible pressure differential across the secondary shield wall. The 1400 square inch suction leg guillotine break at the steam generator nozzle produces the highest differential pressures for the Reactor Coolant System breaks. See Figures 6.2-28a to 28y for the pressure response history for this break for both break flow in Volume 1 and Volume 2. Table 6.2-3 compares the pressures for this break with the design pressure for the compartment wall.

c. Pressurizer Area

The pressurizer area model is defined on Figure 6.2-29. For the pressurizer, a 161 in^2 surge line guillotine break is assumed to occur at elevation 40.67 ft at the pressurizer nozzle (volume 35). In addition, breaks in the spray and relief lines are assumed in the upper pressurizer volume (volume 34).

<u>Upper Pressurizer Compartment</u>

The pressure response in the upper pressurizer subcompartment above EL 62' was assessed for the extended power uprate (EPU) for the double-ended pressurizer relief line, pressurizer spray line and pressurizer surge line breaks, by comparing the estimated mass and energy (M&E) release rates at uprate conditions, with the corresponding values for original design.

It was determined that the M&E release rates for the pressurizer relief line break presented in Table 6.2-22 remain unchanged at EPU conditions. Consequently, the current peak wall differential pressure following the pressurizer relief line break remains unchanged at the EPU conditions.

Taking into consideration the lowest analyzed cold leg temperature of 543°F, the initial EPU M&E release rates following a pressurizer spray line guillotine break is higher than the M&E release rates associated with original design (Tables 6.2-23A and 6.2-23B) by 1.8% and 0.7% respectively. With respect to compartment pressurization, these minimal increases in the M&E release rates are more than compensated by the impact of the increased vent path of approximately 190 square feet due to removal of the missile shield roof of the pressurizer cavity which was included in the original design basis. Consequently, the current peak wall differential pressure following the pressurizer spray line break remains unchanged at the EPU conditions.

Taking into consideration the lowest analyzed cold leg temperature of 543°F, the initial EPU M&E release rates following a pressurizer surge line guillotine break is higher than the M&E release rates associated with original design (Tables 6.2-21A and 6.2-21B) by 0.8% and 0.4% respectively. With respect to compartment pressurization, these minimal increases in the M&E release rates are more than compensated by the impact of the increased vent path of approximately 190 square feet due to removal of the missile shield roof of the pressurizer cavity which was included in the original design basis. Consequently, the current peak wall differential pressure following the pressurizer surge line break remains unchanged at the EPU conditions.

Lower Pressure Compartment

The pressure response in the lower pressurizer subcompartment below EL 62' was assessed for the extended power uprate (EPU) for the double-ended pressurizer surge line break, by comparing the estimated mass and energy (M&E) release rates at uprate conditions, with the corresponding values for original design.

Taking into consideration the lowest analyzed cold leg temperature of 543°F. the initial EPU M&E release rates following a pressurizer surge line guillotine break is higher than the M&E release rates associated with original design (Tables 6.2-21A and 6.2-21B) by 0.8% and 0.4% respectively. Therefore, the maximum differential pressure is conservatively estimated to be approximately 22.7 psid (= 22.5 x 1.008) at the EPU conditions, which is below the design pressure of 24 psid. In conclusion, the design margin for the lower pressurizer compartment wall structure is not significantly impacted at EPU conditions and remains approximately 6% (= (24 - 22.7)/22.7 x 100) at the EPU conditions.

The 161 in^2 guillotine break in the pressurizer surge line at the pressurizer nozzle produces the highest differential pressures for the Reactor Coolant System breaks. Figures 6.2-30a to 30f show the results for the volumes of interest for this break. Table 6.2-3 compares the pressures for this break with the design pressure for the compartment wall.

6.2.1.3 Mass and Energy Release Calculations for Postulated Loss of Coolant Accident

6.2.1.3.1 Description of Blowdown Model

The CEFLASH computer code is used for the generation of LOCA blowdown mass and energy release data for St. Lucie Unit 2. The version used for the original design basis calculations was CEFLASH-4 which was derived from the FLASH-4 code developed by Bettis Atomic Power Laboratory. The EPU LOCA blowdown analysis was done with Version F4A.2.5 of the CEFLASH-4A/FII code. This code is the large break LOCA thermal-hydraulic systems code version and was developed in compliance with Appendix K for ECCS evaluation model analyses. The blowdown time interval when CEFLASH-4A is applied to containment analysis is typically 10 - 25 seconds when the RCS inventory is released to containment. The CEFLASH-4A code is used for both hot and cold leg breaks.

In accordance with the NRC's Standard Review Plan (Ref. 28), the CEFLASH-4A version has been tailored (through input) to maximize the core to coolant heat transfer. By this method, the core is allowed to stay in nucleate boiling except when in heat transfer to steam. In addition, it is allowed to return to nucleate boiling as conditions permit throughout the blowdown transient. Contrary to Appendix K requirements, maximum core to reactor coolant heat transfer is attained such that the energy release to the containment is also maximized.

The technical description of the CEFLASH-4A computer code model is provided in Reference (29). Provided below is a summary of the overall modelling assumptions and conservatisms.

1. The CEFLASH-4A model for the coolant to metal wall heat transfer in a node allows representation of only one wall per node. Accordingly, the thickness used for the overall heat transfer coefficient for each node wall is selected such that the energy released from the system is conservatively modeled.

2. The CEFLASH-4A lumped parameter wall representation uses the total heat capacitance of all the walls in the reactor coolant system that contact the coolant in a given node. This is conservative since, in reality, some of the walls will not participate as effectively as others in the heat transfer process for a large coolant node and heat loss to the ambient surroundings is neglected.

3. Although much of the steel facing the coolant in the reactor coolant system is stainless cladding ($K \approx 12$ Btu/hr-ft-°F), a conservative carbon steel conductivity ($K \approx 26$ Btu/hr-ft-°F) is used for the entire wall. This conservatively overpredicts the energy released from all such walls.

4. Wall to coolant heat transfer is assumed to be conduction limited for all walls; that is, wall surface convection heat transfer coefficients are assumed to be infinite which maximizes the heat transfer.

5. All water volumes are conservatively increased from their nominal design values in order to obtain an upper bound for the available mass and energy in the system prior to a LOCA. Pressure, temperature, and manufacturing tolerance related effects are included in the calculation of an overall volumetric expansion factor for both the RCS and steam generators. This is consistent with the SRPs which require blowdown calculations to be based on hot normal operating conditions.

6. An accepted Jens Lottes two phase heat transfer correlation is used for the core to coolant heat transfer whenever the flow through the core is not pure steam.

7. A maximum core inlet temperature (including uncertainty) and Technical Specification minimum core flowrate are assumed to maximize the available stored energy in the RCS.

8. The core is modeled as 1 radial zone and 5 axial zones. This allows sufficient nodal detail for containment related blowdown calculations.

9. Heat transfer across the steam generator tubes during the transient is modeled with the initial steady state full power overall heat transfer coefficient in both the forward and reverse directions. This is conservative since it maintains a forced convection heat transfer coefficient on the primary side and a nucleate boiling heat transfer coefficient on the secondary side during the LOCA blowdown. Although the RCPs are tripped at the initiation of the transient, this heat transfer coefficient is maintained throughout the transient as a conservative prediction of primary side heat transfer. On the secondary side, the reactor trip following the LOCA would in reality result in a turbine trip which would close the turbine stop valves and the secondary side heat transfer coefficient would decrease to a small natural convection coefficient. Using the initial steady state full power overall heat transfer coefficient conservatively maximizes the reverse heat transfer.

10. For this analysis, no tubes have been assumed to be plugged. Minimizing tube pluggage increases the secondary to primary heat transfer, increases the RCS volume, and minimizes the loop resistance. These effects contribute to a conservative mass and energy release.

11. The decay heat model used in the blowdown calculation is representative of the 1971 ANS standard.

12. The treatment of steam and feedwater flow is handled via input. The CONTRANS containment code was utilized to predict the time to containment high pressure. Adding delay and valve stroke times to this value produced a time dependent table which was utilized in the CEFLASH-4A input. Thus, steam flow is terminated by the closure of the stop valves following reactor trip on high containment pressure plus appropriate signal delays. Feedwater flow is added as a function of isolation valve position over time following MSIS on containment high pressure plus signal delays.

6.2.1.3.2 Description of Core Reflood and Post-Reflood Model

Reflood and Post-Reflood mass and energy release rates of the LOCA are calculated using the FLOOD3 computer code (Ref. 30). Since the refill period (the interval when the reactor vessel refills to the bottom of the active core) is conservatively omitted for containment calculations for containment heat removal considerations, reflood is assumed to follow the initial blowdown phase. The reflood phase is defined as the interval when the reactor vessel level rises, due to safety injection, from the bottom of the active core to the point that the core is quenched. Per SRP Section 6.2.1.3, this is the point at which the level rises to two feet below the top of the active core. The post-reflood period is the interval following the end of reflood to the point that the RCS and steam generators are essentially in equilibrium.

The FLOOD3 code is an extension of the NRC approved FLOOD-MOD2 code (Ref. 9) which was used for the initial design basis analyses. The FLOOD-MOD2 code required separate heat transfer considerations in order to select fluid densities and did not allow time dependent densities. Consequently, it was difficult if not impossible to analyze all possible parametric variations either rigorously or consistently when using FLOOD-MOD2. FLOOD3 uses the FLOOD-MOD2 hydraulics, and reproduces the FLOOD-MOD2 hydraulic solution when consistent sets of hydraulic data are used. FLOOD3 differs from its predecessor in that:

- Intact and broken loops are individually treated,
- Specific volumes of the fluids in the primary loop can be varied with time,
- A uniform methodology for both the Reflood and Post-Reflood time frames is used,
- A more rigorous heat transfer scheme is used for treating the transfer of energy from the loop and steam generator walls to the fluid in the primary loop,
- Containment back pressure may vary with time,
- Safety injection flow rates may be interpolated from a curve or computed explicitly.
- The fluid in the reactor vessel is heated mechanistically, as opposed to assuming saturated liquid in the core.

The intent of the reflood and post-reflood analysis is to extract heat from the hot steam generators following the blowdown phase. Since there is no mechanistic way for exiting steam to pass through the steam generator U-tubes for a hot leg break, the reflood analysis is only conducted for the cold leg breaks. This analysis assumes breaks in the suction and discharge legs.

For the reflood and post-reflood analysis, heat transfer is conservatively modeled for core, vessel walls, vessel internals, loop metal, steam generator tubes, steam generator inventory, and steam generator secondary walls. The FLOOD3 code hydraulics calculates loop flow rates and pressure. The heat transfer process predicts fluid enthalpies and fluid densities are calculated as functions of pressure and enthalpy. The conservatisms in the model are as follows:

a. A one-dimensional heat transfer model is used for all wall heat transfer calculations. It has been demonstrated in past Westinghouse C-E analyses via comparisons of one-dimensional models and otherwise identical two-dimensional models that one-dimensional modeling is conservative.

b. A nucleate boiling heat transfer coefficient of 10,000 Btu/hr-ft^2-°F is used to model the heat transfer from the steam generator tubes to the fluid. This coefficient represents an upper limit, and is conservatively used at all times throughout the tubes.

c. A conservative heat transfer coefficient is used to calculate the secondary to primary heat transfer.

d. The carryover rate fraction (CRF) (the mass ratio of liquid exiting the core to the liquid entering the core) used during reflood is 0.05 up to the 18 inch core level, increases to 0.8 at the 24 inch core level, and is kept at 0.8 until the 9.39 foot level is reached. The level of 9.39 feet is 2 feet below the top of the active core. Other variables, such as core inlet temperature, pressure, flow rate, linear heat rate, or other experimental data are not used to determine the CRF. The assumed CRF is consistent with the prescribed fractions set in the SRPs.

e. Reflood is assumed to terminate when the 9.39 foot quench level in the core is reached.

f. During reflood, credit is taken for the condensation of steam in the annulus by the cold safety injection water. As a conservatism, credit is not taken unless the reactor vessel annulus is full. The safety injection flow is injected directly into the annulus. Also, as an additional conservatism, credit is not taken when the safety injection rate is too low to thermodynamically condense all of the steam in the annulus. The percentage of the total steam flow condensed varies slightly with time for each case. For the suction and discharge cold leg break cases, credit is taken for the condensation of 50% of the total steam flow when the annulus is full and the thermodynamic criteria are simultaneously met. No credit for condensation is taken after the SITs empty.

The post-reflood model is identical to the reflood model except that, at the end of reflood, the CRF is changed from 0.8 to 1.0. This conservatively increases the system flow rates due to the increased CRF. The flow rates are further enhanced by the fact that the core liquid height is now constrained at the 9.39 foot level, which maximizes the available driving head between the annulus level and the core in the FLOOD3 flooding equation. All heat transfer coefficients are kept at the values used for the reflood analysis. Condensation is analyzed as previously described, however, there is not sufficient spillage to completely thermodynamically condense the steam so that credit for condensation has not been taken.

6.2.1.3.3 Description of Long-Term Cooling Model

The heat generation rate from shutdown fissions, heavy isotope decay, and fission product decay is considered during this phase of the LOCA event. As mandated in the SRPs, the fission product decay heat model must be equal to or more conservative than the ANS 5.1 1979 decay heat model. This analysis utilized the ANS 5.1 1979 decay heat model =2σ with long term actinides.

Following the post reflood period outlined above, the mass/energy source terms for long-term containment analysis are computed concurrently with the containment back pressure in the CONTRANS containment code. The steam flows out the break will be a function of the depressurization of the containment, decay heat (plus margin) and primary metal-to-primary fluid heat transfer. The steam generator secondary fluid, tube, thick and thin metal stored energy are used to superheat the steam prior to discharge into the containment.

The long-term energy release data is based on the containment pressure and the following calculational method:

The reactor coolant system is assumed to be a vessel containing a constant mass of saturated water. The pressure in the vessel is assumed to be the containment pressure. SIS water is

injected in the vessel. Steam is formed at a rate determined by decay heat, RCS metal-to-coolant heat transfer and the rate of containment depressurization. Since the water in the vessel is saturated, boiling will occur even without decay heat or metal heat transfer as the containment pressure decreases. The difference between the safety injection rate and the steaming rate is the spillage rate to the sump. It is conservatively assumed that all of the decay and RCS metal heat transfer goes into creating steam. The spillage flow is assumed to have the same enthalpy as the SIS injection enthalpy.

The rate of steam production is

$$m_{stm} = \frac{q_{RCS} - M \frac{du_f}{dt}}{h_g - h_{in}}$$

Where:

m_{stm} = steam flow, lbm/sec

q_{RCS} = decay and RCS metal heat rates, Btu/sec

$M \frac{du_f}{dt}$ = rate of change of internal energy in RCS as a result of depressurization, Btu/sec

h_g = saturated steam enthalpy at containment pressure, Btu/lbm

h_{in} = SIS injection enthalpy, Btu/lbm

The steam created from the decay and RCS metal heat is saturated. For cold leg breaks it is conservatively assumed that all the steam passes through the steam generators and leaves at the secondary side temperature. The long-term energy release to the containment is given by

$$(m\,h)_{Release} = m_{stm}\,h_g + q_{SG}$$

Where:

$(m\,h)_{Release}$ = rate of steam energy release to containment, Btu/sec

q_{SG} = decay and RCS metal heat rates, Btu/sec

6.2.1.4 Mass and Energy Release Analysis for Postulated Secondary System Pipe Ruptures Inside Containment

Mass and energy release analyses for postulated secondary system breaks inside containment are performed for a spectrum of break sizes and power levels in order to assure the identification of the most severe cases for containment analysis. The spectrum of breaks was run using the SGNIII computer code at initial power levels of 100.3, 75, 50, 25 and 0 percent. For each power level, analyses are performed for a full double area break and at decreasing break sizes until that largest break size for which no liquid entrainment is calculated could be identified.

At each power level the break size thus identified will allow the greatest mass and energy release and will therefore determine the most severe containment temperature and pressure conditions for the power level under consideration.

Since the steam generator feedwater ring is below the initial steam generator water level, feedwater break cases will result in liquid entrainment for all but the most trivial break sizes. For this reason, feedwater line break cases are always less severe than steam line breaks at the same power level and a spectrum of feedwater line break cases is not required.

6.2.1.4.1 Mass and Energy Release Data

Mass/energy release data for the most severe secondary system pipe rupture are given in Tables 6.2-12F and 12G.

6.2.1.4.2 Single Failure Analysis

Main steam isolation and main feedwater isolation are initiated simultaneously by a MSIS from the Engineered Safety Features Actuation System. Feedwater flow is automatically terminated by the main feedwater isolation valves (MFIVs) or MFIV backup valves after receipt of a MSIS. The main steam isolation valves also close upon a MSIS. Table 6.2-65 provides the valve closure times and the assumptions used for the main steam line break analysis. Figure 6.2-33 shows the main steam and feedwater piping schematic with pipe volumes between specified nodes.

Analyses have been performed to show that the containment design pressure is not exceeded even if the following single active failures are postulated: (1) loss of one containment heat removal train (i.e., two fan coolers and one spray pump); (2) MSIV failure to close; (3) MFIV failure to close. The assumptions for each case are given below.

Case 1 - Loss of One Containment Heat Removal Train

Since postulation of a steam line break plus the loss of one containment heat removal train assumes a single failure (e.g., loss of one diesel generator set), the MSIVs and MFIVs are postulated to function for this case. The main steam inventory in the line between the faulted steam generator nozzle and the nearest MSIV expands into the containment. The feedwater inventory between the faulted steam generator and its MFIV is assumed to flow into the steam generator where it is released to the containment. One containment spray train, and two containment fan coolers are assumed to operate.

Case 2 - MSIV Failure

A single failure of one MSIV during a postulated main steam line break accident does not cause uncontrolled blowdown of more than one steam generator. The MSIV failure is postulated to occur at the faulted steam generator. Closure of the operational MSIV provides isolation of the intact steam generator. The MFIVs and both containment heat removal trains (two containment sprays and four containment fan coolers) function for this case. The steam inventory from the faulted steam generator up to the closed MSIV on the intact steam generator expands into the containment. The feedwater inventory between the faulted steam generator and its

MSIV is assumed to flow into the steam generator and is released to the containment.

Case 3 - MFIV Failure

A single failure of one MFIV during a postulated main steam line break accident is accommodated by closure of the backup feedwater isolation valves upon receipt of a MSIS. The MSIVs and both containment beat removal trains (two containment sprays and four containment fan coolers) are postulated to operate. The MFIV nearest to the faulted steam generator is postulated to fail. Steam in the steam line between the break and the nearest MSIV expands into the containment. The feedwater inventory between the faulted steam generator and the feedwater backup valve flashes into the affected steam generator.

The feedwater flowrates to the faulted steam generator are calculated for various power level and single active failure cases using the calculated faulted and intact steam generator pressure responses, the feedwater pump characteristics and the feedwater isolation or regulating valve flow coefficients (see Figure 6.2-34).

The feedwater flow rates were reanalyzed during the Stretch Power Uprate and found to be bounded by the values analyzed for Cycle 1. This was due to a 5% margin that was added to the Cycle 1 inventories in preparation for this future upgrade. (Reference 37).

The feedwater flow rates used for Cycle 1 continue to bound the feedwater flow rates for EPU conditions. This is largely due to the effect of the steam generator steam nozzle restrictors. The restrictors tend to reduce the rate of steam generator pressure reduction. The higher steam generator pressure reduces the feedwater flow.

A failure scenario involving the Auxiliary Feedwater System is not explicitly analyzed for the following reasons:

1. The safety grade AFWS to be installed in St. Lucie 2 in response to post TMI requirements is designed such that no single failure will result in delivery of feedwater to a ruptured generator.

2. The revised main feedwater system provides two Safety grade MFIVs in series in each line, so that isolation of main feedwater without additional inventory considerations will occur even if one of the MFIVs fails.

3. The ESFAS logic and the AFWS will feed auxiliary feedwater (as required) to the intact steam generator during a MSLB. The addition of this water to the intact unit was omitted from all MSLB mass/ energy release analyses since the addition of cold water to the intact unit, if considered, would cool the NSSS and hence would provide slower steaming rates from the ruptured unit to the containment.

Offsite power is assumed to be available for the analysis. Availability of offsite power allows the continuation of reactor coolant pump and feedwater pump flow. Maintaining reactor coolant and feedwater pump flow maximizes the rate of primary to secondary heat transfer which maximizes the rate of mass/energy release.

6.2.1.4.3 Initial Conditions

Reactor Coolant System parameters at 100.3 percent of full power are given in Table 6.2-5. The steam generator's pressure program is given in Section 10.1. Feedwater temperature as a function of power level is given on Figures 10.2-1 and 2. The initial steam generator inventory is calculated assuming manufacturing tolerances which maximize the initial inventory. The increase in the initial inventory resulting from thermal expansion of the steam generator is included.

6.2.1.4.4 Description of Blowdown Model

The SGNIII computer code, described in Reference 2, is used for the secondary system pipe break analysis. All significant equations including those for the calculation of primary to secondary, core to coolant and metal to coolant heat transfer and for the calculation of steam separation and moisture carryover are discussed in Reference 7. Experimental justification for all heat transfer coefficients, steam separation velocities, and two-phase flow correlations are provided in Reference 2.

Following closure of the MFIVs, there is an inventory of feedwater between the MFIV and the faulted steam generator. As the faulted steam generator depressurizes, this inventory starts to boil. As steam in the line expands, this feedwater inventory is pushed into the steam generator and is boiled off by primary to secondary heat transfer. The expansion of the feedwater inventory into the faulted steam generator is considered in the blowdown model. The expansion is assumed to be isentropic.

6.2.1.4.5 Deleted

6.2.1.4.6 Additional Information Required for Confirmatory Analyses

The flow area of the main steam lines are as indicated in Table 6.2-1. For the MSLB analysis, the postulated rupture is assumed to occur at the nozzle of one of the steam generators. Therefore, the fL/D from the affected unit to the break is conservatively assumed to be zero. In the MSLB analysis, the fL/D from the intact steam generator to the break is assumed to be approximately 7, which is related to the flow condition of the 34 inch. ID pipe at the steam generator nozzle. Main steam and main feedwater line volumes are given on Figure 6.2-33.

Feedwater flow to the affected steam generator for the most severe MSLB cases listed in Subsection 6.2.1.1 are shown on Figure 6.2-34.

6.2.1.5 Minimum Containment Pressure Analysis for Performance Capability Studies on Emergency Core Cooling Systems

6.2.1.5.1 Introduction and Summary

Appendix K to 10 CFR 50 provides the required and acceptable features of Emergency Core Cooling System (ECCS) evaluation models[12]. Included is the requirement that the containment pressure assumed in the evaluation of ECCS performance not exceed a pressure calculated conservatively for that purpose. The result presented herein is obtained using the method and models approved by the Nuclear Regulatory Commission. This result was used in the ECCS performance analysis for the St. Lucie Unit 2 Cycle 1, which is presented in Subsection 6.3.3.

6.2.1.5.2 Method of Calculation

The calculations reported in this section were performed using the methods described in Reference 13 and approved in Reference 14. In this method, the CEFLASH-4A[15] computer program is used to determine the mass and energy released to the containment during the blowdown phase of a postulated LOCA. The COMPERC-II[16] computer program is used to determine both the mass and energy released to the containment during the reflood phase and the minimum containment pressure response to be used in the evaluation of the effectiveness of the Emergency Core Cooling System.

6.2.1.5.3 Input Parameters

6.2.1.5.3.1 Mass and Energy Release Data

The mass and energy released to the containment for the most severe LOCA, full double ended guillotine on pump discharge, was calculated as a function of time. The quantity of safety injection fluid that is assumed to spill from the break is discussed in Subsection 6.2.1.5.3.5.

6.2.1.5.3.2 Initial Containment Internal Conditions

The initial containment conditions which are used for this analysis are:

Temperature	60°F (minimum)
Pressure	14.33 psia (minimum)
Relative Humidity	100 percent (maximum)

For each parameter, the conservative direction with respect to minimizing the containment pressure appears in parentheses.

6.2.1.5.3.3 Containment Volume

The net free containment volume assumed for this analysis is 2,500,000 ft^3.

6.2.1.5.3.4 Active Heat Sinks

In order to conservatively maximize the heat removal capacity of the containment active heat sinks, both trains of containment spray pumps (two) and fan coolers (four) are assumed to be actuated in the shortest possible time following the break, and to operate at their maximum capacity assuming the minimum temperatures for both the spray water and cooling water. To minimize actuation time for these systems, offsite power is assumed to be available. (It should be noted that offsite power is assumed not to be available for the Safety Injection System). The heat removal capacity of a containment fan cooler is shown as a function of containment temperature in Figure 6.2-35.

The assumed operating parameters for the containment sprays are as follows:

Flow rate	6900 gpm (total, all pumps)
Temperature	55 F

The containment sprays are conservatively assumed to be actuated within 24 seconds from the time of the postulated LOCA. Three of the four fan coolers are assumed to be operating at the time of the postulated LOCA. The fourth fan cooler is actuated in 10.6 sec.

6.2.1.5.3.5 Steam Water Mixing

The effect of condensing containment steam with spilled ECCS water upon the containment pressure is calculated in the manner described in Section III.D.2 of Reference 13.

6.2.1.5.3.6 Passive Heat Sinks

The surface areas and thicknesses of all exposed containment passive heat sinks are listed in Tables 6.2-7 and 8. To conservatively maximize the heat transfer to these passive sinks, the surface areas are assumed to be at the maximum of their uncertainty ranges, and their thermal properties (conductivity and heat capacity) are maximized. The thermal properties assumed for this analysis are:

Material	Thermal Conductivity Btu/ft-h-F	Volumetric Heat Capacity Btu/ft^3-F
Paint on steel	1.67	57.6
Paint on concrete	0.375	47.1
Steel	25.9	53.57
Galvanized steel	64.0	40.60
Stainless steel	9.8	54.0
Concrete	1.0	32.4

6.2.1.5.3.7 Heat Transfer to Passive Heat Sinks

The condensing heat transfer coefficients between the containment atmosphere and the passive heat sinks have been calculated in the manner described in Section III.D.2 and Figure III.D.2-2 of Reference 13. The variation of the condensing heat transfer coefficients as a function of time is shown qualitatively on Figure 6.2-37.

6.2.1.5.3.8 Containment Purge System

The analysis presented in this subsection includes the effects of the eight inch continuous containment purge system. The continuous containment purge system is assumed to be operating at the time of the postulated LOCA. The purge system isolation valves are assumed to be fully closed 5.0 seconds after a containment isolation actuation signal was generated by high containment pressure (6.0 psig). It is conservatively assumed that only dry air is removed from the containment atmosphere.

6.2.1.5.4 Results

For the most severe LOCA, a full double ended guillotine on pump discharge, the minimum containment pressure response to be used in analyzing the effectiveness of the ECCS is shown on Figure 6.2-38. The responses of the containment atmosphere and containment sump temperatures are shown on Figures 6.2-39 and 40, respectively.

6.2.1.6 Testing and Inspection

6.2.1.6.1 Preoperational Testing and Inspection

Preoperational testing of the containment structure and associated systems and components is described in Section 14.0. A description of the pre-operational containment leak test program is given in Subsection 6.2.6.

6.2.1.6.2 Inservice Testing and Inspection

a. Containment Vessel

Periodic "Type A, B and C" leakage rate tests will be conducted in accordance with Appendix J, "Reactor Containment Leakage Testing for Water Cooled Power Reactors," 10 CFR 50, to verify the continued leak-tight integrity of the containment. Technical Specification Amendment 88, dated February 10, 1997, was approved which allows Appendix J, Option B testing. This testing allows the licensee to establish intervals for containment leak-testing based on the performance history and risk significance of the components (containment, penetrations, and valves). All Type A, B, and C testing requirements will be performed at intervals determined by the containment leakage rate testing program (See Technical Specification 6.8.4). The criteria for the new testing intervals is evaluated based on individual performance history and the permitted intervals specified in NEI 94-01.

After the initial preoperational leakage rate tests, a set of three "Type A" tests will be performed at approximately equal intervals during each 10 year service period, with the third test coinciding with the end of the service period (Note that these service intervals have changed based on Appendix J, Option B testing).

"Type B" tests will be performed during each major refueling but in no case at intervals greater than two years. Air locks and door seals will be tested in accordance with Technical Specifications. "Type C" tests will be performed during each reactor shutdown for major refueling but in no case at intervals greater than two years. The applicability of these tests to the containment isolation valves is discussed in Subsection 6.2.4 and Technical Specifications (Note that these service intervals have changed based on Appendix J, Option B testing. See also Technical Specification 6.8.4).

The results of "Type A, B and C" leakage rate tests will be reported in a summary Integrated Leak Rate Test report available for inspection at plant site. Leakage tests that fail to meet the acceptance criteria will be reported in a separate summary that includes an analysis and interpretation of the test data. Results and analyses of supplemental verification tests employed to demonstrate the validity of the leakage rate test measurements will also be included (Note: Reporting requirements are based on the containment leakage rate testing program).

A steel containment vessel, designed, fabricated, inspected and pressure tested in accordance with the ASME Section III and protected by the concrete Shield Building will offer continued structural integrity over the life of the unit. The vessel receives a code stamp from an authoritative body which represents the most recent developments in the techniques of pressure vessel design and fabrication that are

backed up by years of research, testing and successful inservice experience. Therefore, it is contemplated that there will be no need for any special in service surveillance program other than visual inspection of the exposed interior and exterior surfaces of the containment vessel as described in the Technical Specifications and the containment leakage rate testing program.

b. Shield Building

Periodic tests of the Shield Building and its ventilation/filtration system will be conducted to verify both system capacity and performance and building leaktight integrity. Periodic testing is discussed in the plant Technical Specifications and will be performed per the frequency and acceptance criteria of the plant Technical Specifications and the Containment Leakage Rate Testing Program.

6.2.1.7 Instrumentation Application

Instrumentation required to monitor containment conditions and actuating those systems and components having safety functions are discussed in Sections 7.2 and 7.3.

6.2.2 CONTAINMENT HEAT REMOVAL SYSTEMS

The Containment Heat Removal System which consists of the Containment Cooling System (CCS) and Containment Spray System (CSS), is provided to remove heat from the containment, thereby reducing the containment pressure and temperature, and maintaining them at acceptably low levels following an accident. The Containment Heat Removal System is arranged into two independent 100 percent capacity subsystems, each of which is comprised of one containment spray train and two fan coolers. Heat removal is achieved by the simultaneous operation of the two subsystems.

The CSS is designed to remove both heat and fission products from a postaccident containment atmosphere by spraying water from ring headers located high in the containment. The fission product removal capability of this system is discussed in Subsection 6.5.2.

The CCS fan coolers are designed to operate during normal plant operation and following a loss of coolant accident (LOCA) or a main steam line break (MSLB) inside containment. The outlets of the fan coolers are connected to a ductwork system which transports cooled air to various regions of the containment atmosphere.

6.2.2.1 Design Bases

The design bases for the Containment Heat Removal Systems include the following:

a. The Containment Heat Removal System is designed to ensure its capability to accommodate the source of energy, the energy release rate and the integrated energy release due to the postulated accidents outlined in Subsections 6.2.1.3 and 6.2.1.4.

b. The Containment Heat Removal System is part of the Engineered Safety Features (ESF) which will function immediately following an accident. Only one of the two independent subsystems (one CS pump and two fan coolers) is required to prevent

the pressure and temperature in containment from reaching unacceptable levels following an accident.

c. Each Containment Heat Removal subsystem was procured to reduce post-accident containment pressure to less than one half its peak value within 24 hours.

d. The components of the Containment Heat Removal System located inside containment are designed to operate under accident conditions for extended periods. The post-accident environment and the environmental qualification of equipment is described in Section 3.11.

e. The Containment Heat Removal System is designed such that no single failure can prevent it from performing its design function. Two of four fan coolers and one CSS loop are powered from an independent safety bus and the other subsystem is powered from the other independent safety bus. Loss of one bus does not affect the ability of the Containment Heat Removal System to maintain containment temperature and pressure below the design values.

f. Components of the Containment Heat Removal System which are necessary to support the system safety functions and are located inside containment are designed to Quality Group B, seismic Category I requirements.

g. The Containment Heat Removal System is designed to withstand the effects associated with piping failures (see Section 3.6 and associated appendices).

h. The Containment Heat Removal System incorporates provisions for periodic inspection and testing as described in Subsection 6.2.2.4.

6.2.2.2 System Design

Containment heat removal is accomplished by the combined effect of the Containment Spray System and the Containment Cooling System. These systems are described separately below.

6.2.2.2.1 Containment Spray System

The Containment Spray System (CSS) consists of two independent and redundant trains each consisting of a spray pump, shutdown heat exchanger, piping, valves, and spray header as shown on Figure 6.2-41. The system has two modes of operation:

a. The initial injection mode, during which the system draws water from the refueling water tank (RWT).

b. The recirculation mode during which the CSS takes suction from the containment sump for long term cooling.

Containment spray is automatically initiated following receipt of the containment spray actuation signal (CSAS), which is a coincidence of the safety injection actuation signal (SIAS) and the high- high containment pressure signal of 5.4 psig (refer to Section 7.3). Upon receipt of the CSAS, the containment spray pumps are started and isolation valves FCV-07-1A and FCV-07-1B are opened. The system can be manually controlled both locally and from the control room. During this mode, the containment spray pumps take suction from the RWT and spray borated

water directly into the containment atmosphere. Although the spray water first passes through the shutdown heat exchanger, no significant heat load is placed on the exchanger during this mode of operation. This period of injection lasts for a minimum of 20 minutes assuming system runout flow for two high pressure safety injection (HPSI) pumps, two low pressure safety injection (LPSI) pumps, and two containment spray (CS) pumps, with the RWT at the Technical Specification level (see Section 6.3 and Subsection 6.5.2). System delay times are given in Figures 6.2-42 and 43.

When a low level in the RWT is reached (see Section 7.3), the recirculation actuation signal (RAS) is initiated. This closes RWT isolation valves MV-07-1A and MV-07-1B in 90 seconds and opens containment sump isolation valves MV-07-2A and MV-07-2B in 30 seconds. These valves can be manually operated locally or from the control room. MV-07-1A, MV-07-1B, MV-07-2A and MV-07-2B are subject to the requirements of NRC Generic Letter 89-10. The motor operators on these valves are designed such that the sump isolation valves open faster than the RWT valves close, thus insuring continuous suction for the spray pumps. Further, enough water is maintained below the low level point in the RWT to maintain supply throughout the closure of the RWT isolation valves. Should, however, one of the RWT valves fail to close, the water seal created by the difference in elevation between the containment sump water level and RWT level would prevent air from being drawn into the system.

The setpoints for the actuation signals are described in Section 7.3 and the rationale for establishing the setpoints are based on Subsections 6.2.1.3 and 6.2.1.4 analyses.

As discussed in NRC Generic Letter 2008-01 and INPO SER 2-05, the presence of unanticipated gas voids within fluid systems can challenge the ability of systems to perform their design functions due to issues such as gas binding, water hammer, injection delay times, etc. Requirements for maintaining Containment Spray system operability with respect to gas intrusion are contained within Technical Specifications and Gas Accumulation Management Program procedures.

The containment sump is a large reservoir, designed in accordance with the Regulatory Guide 1.82, "Sumps for Emergency Core Cooling and Containment Spray Systems", June, 1974 (RO) provides for long-term recirculation.

Ongoing research and new guidance from the NRC have resulted in the need for upgrades to the containment sump system at St. Lucie Unit 2 (PSL-2). Operating experience identified new contributors to debris and possible blockage of PWR sumps, such as degraded or failed containment paint (coatings). Thus, NRC Generic Safety Issue 191 (GSI-191), “Assessment of Debris Accumulation on PWR Sumps Performance,” was created in 1998.

In issuing report NUREG/CR-6762, NRC research determined that post-accident sump blockage is a generic concern for PWRs. On September 13, 2004, the NRC issued Generic Letter 2004-02 (GL 2004-02), which required all licensees to address planned actions to mitigate the potential impact of debris blockage on Emergency Recirculation during design basis accidents at Pressurized Water Reactors.

In response to GL 2004-02, FPL committed to modifications to the PSL-2 existing sump screen system to meet the applicable regulatory requirements discussed in the generic letter. According to the response, “Corrective actions will be implemented to ensure that the [ECCS] and [CSS] recirculation functions under debris loading conditions will be in compliance with the Applicable Regulatory Requirements section of [GL 2004-02] when all modifications are

completed. The licensing basis will be updated to reflect the results of the analysis and modifications performed to demonstrate compliance with the regulatory requirements. This update will be performed in accordance with the requirements of 10 CFR 50.59."

A design modification implements "correction actions" (namely, the installation of new sump strainers) to support the ECCS and CSS recirculation functions under debris loading conditions. The installed sump strainer configuration meets the functional and design basis requirements of the existing sump and screen. New downstream effects concerns identified by GL 2004-02 will continue to be addressed through industry initiatives for resolution and closure of GL 2004-02.

Sump strainer configuration can be seen on Figure 6.2-44 and is discussed in Subsection 6.2.2.2.3.

During recirculation, spray flow drawn from the sump is first cooled by the shutdown heat exchanger before returning to the containment through the spray nozzles.

Each train of containment spray contains four spray ring headers located high in the containment. Each header contains numerous spray nozzles designed to produce widely dispersed sprays with fine droplets for enhanced heat removal capabilities. A complete discussion of the ring headers and spray nozzles is found in Subsection 6.2.2.3.

All portions of the CSS located inside containment are designed to operate in environmental conditions associated with a post-accident containment atmosphere. Environmental qualification of components is described in Section 3.11. All system components are fabricated of corrosion resistant materials as indicated in Table 6.2-38. Design codes and standards are also identified in Table 6.2-38.

6.2.2.2.2 Containment Cooling System

The Containment Cooling System (CCS), shown on Figures 9.4-1 and 9.4-9 consists of four coolers, a ducted air distribution system (Figures 6.2-46 and 6.2-47) and the associated instrumentation and controls. Each fan cooler consists of an axial flow fan, two speed motor, casing, two banks of cooling coils, and back draft damper. The design and performance data are shown in Table 6.2-38. The design codes and standards are also specified therein.

The system has two modes of operation which are:

a. Normal Operation - during which three fan coolers are operating at a rated flow of 60,000 CFM each, with high speed motor operation.

b. Accident Operation - during which at least two fan coolers are operating at a reduced flow of 39,600 CFM each, with low speed motor operation.

During normal operation three of the four fan coolers are operating at the higher of the two speeds. As discussed in Subsection 9.4.8.4.1, the Containment Fan Cooling system is required to maintain reactor supports within design limitations.

Upon receipt of SIAS, the four fans are automatically placed into low speed operation (39,600 CFM) within 10 seconds if offsite power is available and 23 seconds if unavailable. For system delay times, see Figures 6.2-42 and 43. For a discussion of the rationale behind selection of

setpoints for CCS actuation, see Section 7.3. No operator intervention is required to initiate fan cooler emergency operation.

Each fan cooler unit is sized to remove one-third of the total normal containment heat load. Containment ambient temperature is limited to an average of 120 F when the units are supplied with 100 F component cooling water.

Each cooling coil bank is made up of coil sections connected to supply and return manifolds of the Component Cooling Water System (CCWS). Coils are horizontal tube, vertical plate-fin type, and are mounted on a structural frame. Cooling coil frame, cooling coils, coil header, stub and flange materials are given in Table 6.2-38. The flow to the coils from the CCWS is monitored by a low flow alarm.

Cooling coils are provided with individual stainless steel drain pans and drain piping to prevent flooding of lower coils by condensate cascading from upper coils. Condensation is drained to the reactor cavity sump. The cooling coils are designed to ASME Code, Section III, Code Class 2 requirements. Hydrostatic testing to 300 psig and bubble testing to 200 psig are performed.

The fans are axial type, direct motor driven, with air foil adjustable blades. The motors are totally enclosed air-over type, therefore the fan bearings do not contact the air stream. Bearings have a minimum B-10 life as defined by Anti-Friction Bearing Manufacturer's Association (AFBMA) of 100,000 hours under normal operating conditions. Fan housing is of welded steel construction and reinforced to withstand the transient pressure rise following an accident.

The casing of the containment fan coolers, ring header, and duct riser from the ring header to inside the secondary shield wall are required to remain intact following an accident. The casing of each fan cooler is reinforced to withstand a pressure differential of two psi in any direction. It is constructed of 3/8 inch carbon steel plate in the bottom and 3/16 inch plate for vertical walls.

Adequate quantity of relief dampers have been provided in the ring header and duct risers to limit the differential pressure to 20 in. wg or less. Relief dampers are designed in accordance with American Air Filter Topical Report AAF-TR-7101, "Design and Testing of Fan Coolers - Filter Systems for Nuclear Applications". This report was accepted by the NRC per letter dated November 10, 1972. Relief dampers are designed to withstand accident induced pressure transients as indicated in Subsection 6.2.1. To withstand a differential pressure of 20 in. wg, the ring header and duct risers are constructed with 14 gage galvanized steel with reinforcing angles. Blowout panels are provided on the duct risers between the fan coolers and ring header. These attenuate high pressure transmission from inside the secondary shield wall area through the duct. Blowout panels are engineered to open at a differential pressure of 1.25 psi. In addition, to prevent any damage to the fan coolers, gravity dampers are also provided at the discharge side of the fan. Gravity dampers are designed to withstand a differential back pressure of 1.5 psi.

The fan coolers are located outside the secondary shield wall in four different quadrants of the containment: three on elevation 45 ft. and one on elevation 62 ft. This arrangement provides separation and minimizes recirculation between units. The discharge side of the fan coolers are connected to the ring header manifold to provide mixing of air at elevation 105 feet. Adequate quantity of supply registers or air outlets are provided around the periphery of the ring header blowing air toward the center of containment. To enhance mixing of air above the ring header, some of these air outlets are directed upward to the top of the dome. The rest of the air outlets are located at various parts and inside of the secondary shield wall from elevation 45 ft. down to

elevation 26 ft. For a given air flow, each register is sized to give a horizontal throw of approximately 40 ft. (average) that covers a wide area and gives an outlet velocity that induces mixing of containment air. Air mixing is also accomplished by convection. Cold air from the ring header will settle downward displacing hotter air. The colder air is heated causing it to rise toward the suction of the fan coolers. By verifying the air flow of each register and the cooling performance of the cooling coils during pre-operational testing, the adequacy of mixing the containment air by fan coolers is assured. See Figures 6.2-46 and 6.2-47 for plan and elevation views showing the ductwork and the location of outlet registers.

Provisions made to facilitate periodic testing of the Containment Cooling System are discussed in Subsection 6.2.2.4.

Environmental qualification of system components is addressed in Section 3.11.

The analysis of the stretch power impact on the Containment Cooling System has proved that the system is capable of operating without any modification at the increased power level (2710 MWt).

6.2.2.2.3 Containment Sump Design

The containment sump is a large collecting reservoir provided to supply water to the Containment Spray and Safety Injection Systems for long-term recirculation. Design of the containment sump, which follows the recommendations outlined in Regulatory Guide 1.82 (R0), is described in the following paragraphs:

a. A large capacity sump, enclosing the redundant suctions of the ECCS and the CSS which are separated by approximately 15 ft. is provided for continuous recirculation.

b. The sump is separated from the Reactor Coolant, Main Steam, and Feedwater Systems by the secondary shield wall. Where necessary, such as in the case of safety injection tank piping and charging lines, design provisions are made to protect the sump from effects of piping failure. For a more complete discussion, see Section 3.6.

   The Reactor Drain Tank, also located in the sump, is designed to remain in place following an accident. The effect of uplift loads resulting from the submergence of an empty tank have been analyzed and found to be well within the capabilities of the hold down bolts. A Containment Isolation Actuation Signal (CIAS) isolates the tank and stops and drain pumps.

c. The sump is located at the lowest floor elevation in the containment (exclusive of the reactor cavity sump) and is shielded by two filtering devices; an outer trash rack, and a strainer system. The strainer system is composed of the following two primary assemblies:

   1. Eight vertical strainer stacks composed of individual disks formed by perforated sheet, bolted together in vertical stacks with intermediate stiffener support plates, and a core tube for flow of water down to the plenum. Each stack is laterally supported via carbon steel brackets fastened to the south sump wall, which has steel embedment plates. The strainer stacks and plenum are fastened to the

base structure to provide adequate gravity and seismic support without inducing significant thermal loading on the strainer assemblies.

2. A stainless steel framed substructure, which acts as a flow plenum that is sealed for the design debris particle size and supports the loads from the strainer stacks that rest on top of the plenum. The plenum also extends down to the sump floor at elevation 7'-7" at the ECCS suction pipe inlets. The plenum is mounted to the Elevation 7'-7" floor and the walls at Elevation 11'-0" concrete ledge.

With this strainer system design, as shown in Figure 6.2-44, fluid is filtered by the strainers prior to reaching the safeguards systems suction lines.

d. Drains from the various regions of the containment are directed to the sump via vent openings in the secondary shield wall. These vent openings have coarse grating acting as trash racks that prevent debris laden water from impinging on the screens that enclose the sump.

e. Large debris is prevented from reaching the sump by the trash racks placed at the secondary shield wall vent openings. These racks are designed to withstand the effects of the SSE and remain functional to the above design requirements. Small debris including insulation on piping and equipment is considered to be the primary source of post-accident debris inside containment, which could potentially clog the sump strainers.

There are two types of thermal insulation used inside the RCB. They are:

1) Metal Reflective

2) Metal Encapsulated

The metal reflective insulation is built of stainless steel panels. The panels consist of interior and exterior sheets. It is estimated that the total area of metal reflective insulation is 6182 square feet. This insulation is used on the Reactor Vessel and Reactor Coolant Pumps.

The second type of insulation (Type A), metal encapsulated, occurs in two forms.The predominant form consists of a fiberglass insulating wool blanket encapsulated in fiberglass cloth contained within a metal jacket. Fiberglass insulation encapsulated with metal is also used for anti-sweat insulation.

The estimated quantity of this type insulation used inside containment appears in Table 6.2-40.

Another form of metal encapsulated insulation (Type B) occurs on small bore lines and forms a part of some support/restraint structures. These pieces, or pipe shields, are half cylinders of calcium silicate and marinite held together around the pipe by its interlocking stainless steel jacket. Two stainless steel clamps are provided around each unit. A small quantity of calcium silicate insulation is also used on piping located outside of the biological shield wall. This insulation is held together by stainless steel jackets and is designed to remain in place during and after a seismic event. The calcium silicate insulation used outside the biological shield wall is

located above the maximum flood level and is not subject to transport to the sump strainers. Due to the small size of these units and their wide dispersion in the RCB these units present no hazard to plugging of the sump strainers.

Both types of insulation are designed to remain in place during and after a seismic event. All insulation is designed and constructed to not be adversely affected by postulated accident environmental conditions. Refer to Table 6.2-39. Following an accident the only insulation that will be dislodged is that in the vicinity of a high energy line break or in the direct path of the resultant jet. All other insulation will remain in place. Any dislodged metallic insulation will settle out of water flow in the bottom of containment. Approach flow velocities are expected to be too low to transport heavy metallic assemblies. In any case the trash racks at the secondary shield wall vent openings will prevent these assemblies from reaching the sump.

Fiberglass insulation assemblies have undergone substantial testing by Owens/Corning (Topical Report OCF-1). These tests were designed to determine the behavior of the insulation under accident conditions and to ensure that the containment sump operation is not impaired. The results of these tests demonstrate that this insulation is suitable for use inside the containment and does not obstruct the flow through containment sump strainers. This report was reviewed and endorsed by the Nuclear Regulatory Commission.

f. The containment sump strainer system encloses the sump suction lines. The overall gross surface area is approximately 5600 ft^2. The surface area is sufficient to provide adequate NPSH to the ECCS and CS pumps considering the postulated debris loading, including a limiting fiber bed condition. In addition, a seismically supported vertical sump divider plate is provided in the strainer plenum to separate the redundant suction lines. The perforated plate hole size for the plenum divider plate is sized to a nominal diameter of 0.0625 inches to avoid entrapment of particles greater than a size of 0.135 in the HPSI discharge throttle valves and allows flow between the two sides of the strainer plenum.

g. The strainer system is designed to withstand the effects of the SSE. Limiting the perforated plate hole size to a nominal diameter of 0.0625 inches controls the maximum allowable debris size that can pass through the strainers. Particle retention is 100% of particles larger than 0.06875 (+0). The perforated plate hole size was selected to avoid entrapment of particles greater than 0.090” in diameter (nominal value Ref. 36) in the fuel assembly spacer grids. The strainer system is made of Type 304 stainless steel (except support attachments) to resist corrosion and structural degradation.

h. Two carbon steel guard pipes extend from the containment sump inside containment to outside the Shield Building wall. Each pipe is directly welded to a steel containment vessel nozzle and is an extension of the nozzle in both directions. Passing through each carbon steel pipe is a stainless steel sump suction line which connects the containment sump to the suction of the engineered safety feature pumps. The stainless steel pipes are welded to the carbon steel pipes at the containment sump so that water cannot enter the annulus formed by the concentric pipes. Outside the containment the stainless steel pipes are sealed to the guard pipes by means of a stainless steel bellows. The bellows seal allows for anticipated differential movement due to thermal or seismic forces.

i. The containment sump strainers are designed to limit air ingestion to less than 2%. The containment sump strainers were evaluated taking into consideration NRC guidance regarding air ingestion and vortexing. Reg. Guide 1.82 states that vortexing can lead to air ingestion. Thus the evaluation considers any vortexing to be unacceptable. Reg Guide 1.82 recommends limiting air ingestion to less than 2% by volume.

   The evaluation of the containment sump strainers for vortexting is based on PCI prototype testing and application of general vortexing limiting features as described in Reg. Guide 1.82. The test results showed no vortexing and use of the general vortexing limiting features in the construction of the PCI strainers preclude the formation of vorticles. Thus there are no vortexing concerns.

   The containment sump evaluation and Table A-1 of Reg Guide 1.82 indicate that sump performance specifically related to air ingestion is a strong function of the Froude Number, Fr. By limiting the Froude Number to a maximum of 0.25, air ingestion can be maintained to <2%. The containment sump evaluation determined that the Froude Number for the PCI Sure Flow strainers is less than 0.25. Therefore due to the combination of a low Froude Number and lack of an air entrainment mechanism (i.e., vortext formation) in conjunction with the complete submergence of the strainer, air ingestion is not expected to occur.

   The elevation in relation to structures can be seen on Figures 1.2-10 and 1.2-11. In compliance with NUREG-0737, the containment is provided with redundant means of post-accident water level indication consisting of one narrow range and two wide range level monitors. The wide range monitors are capable of measuring water level from the lowest point in the containment up to the maximum postulated flood level. These indicators are fully qualified for use inside containment, safety-related (Category 2 as defined in Reg. Guide 1.97) and seismic Category I. Further description can be found in Subsection 7.5.3.2.

j. Removable platforms are provided to permit visual inspection of the sump.

6.2.2.3 Design Evaluation

The structures and components inside containment absorb energy released after an accident, acting as heat sinks. However, this does not prevent containment pressures and temperatures from reaching unacceptable levels and therefore, some active means of heat removal must be provided. The Containment Spray System and the Containment Cooling System are provided as means for containment heat removal. Diverse and separate actuation signals for each system with fully redundant channels within each system have been provided for greater reliability. For a discussion of safety grade signals, see Section 7.3.

Accident analyses given in Subsection 6.2.1 demonstrate that any one of the two independent subsystems, consisting of one spray pump and two fan coolers, can maintain post-accident containment pressures and temperatures within acceptable levels. Also Subsection 6.2.1 gives the integrated energy content of the containment atmosphere, sump fluid, and heat sinks following an accident.

A single failure analysis is made on active components of the Containment Heat Removal System to show that minimum required heat removal capability remains after any single failure.

Table 6.2-41 demonstrates that no single failure, up to and including that of an emergency diesel generator, can prevent the functioning of at least one containment pump and two fan coolers.

System design is guided by General Design Criteria 38, 39 and 40; and Regulatory Guides 1.1, "Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal System Pumps," November, 1970 (R0); 1.26, "Quality Group Classifications and Standards for Water, Steam, and Radioactive-Waste-Containing Components of Nuclear Power Plants," February, 1976 (R3); 1.29, "Seismic Design Classification," February, 1976 (R2), and 1.82 (R0). Specific codes governing component design can be found in Table 6.2-38.

6.2.2.3.1 Containment Spray System Evaluation

Following receipt of CSAS, which occurs when containment pressure reaches 11 psig, both spray pumps automatically start and both containment spray isolation valves open. Since the RWT supply line isolation valves are in the normally open position, no active failure can prevent positive suction to the spray pumps. When operating in the injection mode, a net positive suction head (NPSH) of 48.5 feet is available at the pump. This assumes a maximum fluid temperature of 100°F and takes no credit for the height of fluid in the RWT. The NPSH required is 31.8 feet; for a tabulation of parameters used in the calculation of the available NPSH, see Table 6.2-42. Upon receipt of the CSAS, the spray pumps begin delivering flow through the spray nozzles in 23.5 seconds with offsite power available and in 45.5 seconds without offsite power. Full flow is achieved in 36.5 or 58.5 seconds, with and without offsite power respectively.

A CSS analysis is presented on Figure 6.2-48. During injection, the system delivers between a minimum of 2800 gpm and a maximum of 3020 gpm against a containment pressure of 44 psig, depending on RWT water level. When atmospheric pressure exists in containment, the system delivers between 3400 and 3600 gpm. Of the above flows, 150 gpm is used for continuous pump recirculation (injection phase only).

Following receipt of recirculation actuation signal pump suction is automatically switched to the containment sump. Following an accident, the pressure inside containment exceeds the saturation pressure corresponding to sump water temperature. No credit, however, is taken for this favorable situation. As required by Regulatory Guide 1.1 (R0), NPSH calculations are performed for the entire range of sump temperatures, 80F to 240F, and the minimum containment pressure physically possible, i.e., sump water saturation pressure. Further, it is assumed that the sump is filled to elevation 23.38 feet following the design basis LOCA. The minimum NPSH available at EPU conditions for the CS pump during recirculation, at the limiting plant specific containment sump water temperature of 192°F, for the design basis case is approximately 32.5 feet. Manufacturer's test results indicate that no more than 23.9 feet is required over the entire pump range demonstrating that adequate NPSH is available at all times (see Table 6.2-42).

While in the recirculation mode, containment spray essentially acts as a closed system delivering a fixed flow independent of containment pressure. As indicated on Figure 6.2-48, a fixed flow of 3560 gpm is maintained during recirculation.

While in the recirculation mode, the spray flow is cooled in the shutdown heat exchanger, which rejects heat to the Component Cooling Water System. Each heat exchanger is sized to remove approximately 87 million BTU/hr, cooling the spray flow from 240 to 172°F, assuming a component cooling water supply temperature of 120°F.

Each train of the CSS has a supply header and four spray nozzle rings located high in the containment. Each train has a minimum of 178 spray nozzles. The following CSS design provisions are made to maximize the heat removal capability of the system:

a. The nozzle rings are located as high as practicable inside containment (see Figures 6.5-4 and 6.5-5). Spray droplet fall heights range from 107 to 154 feet down to the operating floor at elevation 62 feet.

b. The nozzles produce widely dispersed 60 degree cone spray patterns. The typical drop size distribution and pattern distribution of a nozzle spraying vertically down are provided on Figures 6.5-6 and 7. Substantial spray pattern overlap insures adequate coverage of the containment cross section (see Subsection 6.5.2).

c. Nozzles are designed to produce small droplet sizes to enhance heat transfer characteristics. The selection of droplet size is also based on maximum fission product removal and is discussed in Subsection 6.5.2. Method employed to determine the mean spray drop size is described in Subsection 6.5.2.4.

d. The nozzles are passive devices which produce constant spray patterns without moving parts.

e. The nozzle orifice size is larger than the maximum particle size postulated in the flow path and thus are not subject to clogging.

The nozzles used are manufactured expressly for use in nuclear power plants. Nozzle design data appears in Table 6.2-43.

6.2.2.3.2 Containment Cooling System Evaluation

The heat removal rates of the fan coolers as a function of containment atmosphere temperature, for normal and accident conditions, are shown on Figures 6.2-49 and 6.2-50. Table 6.2-44 shows the heat and condensate removal rate for specific values of containment air/steam temperature and component cooling water temperature.

A fan cooler heat transfer test program was conducted by American Air Filter. The temperature, pressure and humidity were varied for each test by controlling the steam-to-air ratio and velocity of saturated air entering the coil. Heat removal capacity at the coil was measured for specified cooling water flowrates.

Since the fan coolers are serviced by the Component Cooling Water System, which is a closed system, no significant fouling effects are expected.

Cooling coils in the containment fan coolers have been designed with an anticipated water fouling factor of 0.0005. Fouling factor is primarily influenced by water chemistry, velocity and temperature. During accident conditioning only the water temperature will change, from approximately 102°F inlet to 206°F outlet. According to TEMA standards, for clean, treated water, fouling factor will not change over this temperature range. Therefore, the heat removal capability of 61.6 x 100 BTU/Hr, (original procurement value), based on component cooling water entering temperature of 100°F, of each fan cooler will remain unchanged during accident conditions. Note that this bounding capability reflects performance of a clean CCW Heat

Exchanger as procured to the original specifications. The actual heat load from the analysis at any given time will be different.

6.2.2.4 Tests and Inspection

6.2.2.4.1 Containment Spray System

The containment spray pumps are qualified for operability by being subjected to tests by the manufacturer. Among the tests performed are:

a. Hydrostatic test of the pump casing at 150 percent of maximum operation pressure.

b. Suction pressure suppression test to verify NPSH requirements over entire pump capacity range.

c. Transient test of 40°F to 240°F in 10 seconds to conservatively simulate switch-over from RWT to sump suction.

d. Measurements to verify minimum pump casing wall thickness.

e. Seal leakage tests.

To verify that the system responds and performs its function as required, system tests are performed at intervals during reactor shutdowns for refueling or scheduled maintenance. The tests are performed with the isolation valves in the spray lines blocked and utilizing the miniflow test line connecting the pump discharge to the refueling water tank. Pressure and flow indicators are provided to verify measured pump performance characteristics. Operation of the system is initiated by tripping the actuation instrumentation. The test is considered satisfactory if visual observations indicate that all components operate as required. Surveillance requirements are a part of the Technical Specifications. As discussed in NRC Generic Letter 2008-01 and INPO SER 2-05, the presence of unanticipated gas voids within fluid systems can challenge the ability of systems to perform their design functions due to issues such as gas binding, water hammer, injection delay times, etc. Requirements for maintaining Containment Spray system operability with respect to gas intrusion are contained within Technical Specifications and Gas Accumulation Management Program procedures.

The spray nozzles are subjected to testing by the manufacturer. Tests to verify pressure drop, spray pattern, and droplet size are performed in the shop (see Subsection 6.5.2). In situ surveillance testing is performed in accordance with the Technical Specifications.

Active components of the CSS are required to remain functional during and subsequent to an accident. The equipment manufacturer is provided with the component design parameters, system transients, and seismic perturbations in order to qualify his equipment. The results of the operability tests are provided in Appendix 3.9A.

Removable inspection plates are located on both sides of the strainer plenum. The plates allow access to the inside of the strainer plenum to perform visual inspections of the strainer and ECCS suction lines.

6.2.2.4.2 Containment Cooling System

Components of the containment fan coolers are performance tested in the manufacturer's shop and then tested and balanced after installation in the plant to demonstrate the proper functioning of the system. Prototype performance tests for motors are conducted under simulated accident conditions in accordance with IEEE 334-1974, "IEEE Standard for Type Tests of Continuous Duty Class 1E Motors for Nuclear Power Generating Stations." Testing of the fan coolers is performed in accordance with American Air Filter Topical Report AAF-TR-701, "Design and Testing of Fan Cooler-Filter Systems for Nuclear Applications," February 1972.

For maintenance, servicing and visual inspection of containment fan coolers, access doors are provided in the housing. Fans, dampers and cooling coils are installed in such a way that these components can be removed for servicing. Flow ports and thermocouples are provided for testing the fan performance and heat removal capability of the cooling coils respectively.

The heat removal capability of the cooling coils is verified by noting the temperature readings in the control room.

An initial fan performance test is conducted.

6.2.2.4.3 Containment Sump Strainer

Performance testing was performed on a PCI Sure Flow prototype strainer module to determine head loss of the strainer that bound all plant design conditions. The performance testing of the PCI strainer incorporated the following:

a. The prototype strainer module represents one module of the 8 stack vertical strainers installed. The scaling of strainer module flow and debris amount was determined by calculation.

b. The debris input is representative of the various types of debris, amounts generated and transported based on the debris generation and transport calculations.

c. The following tests were performed:

    1. Clean Strainer Head Loss - determined the head loss of the clean strainer.

    2. Fibrous Debris Only - This test included only fibrous debris to establish transport characteristics of the fibers and evaluated how the fibrous debris bed is formed.

    3. Design Basis Debris Loaded Strainer Head Loss - determined the debris bed head loss for the design basis accident.

    4. Particulate Debris Only Head Loss - determined the debris bed head loss for only particulate debris.

An inspection program has been developed to verify that the containment is free of debris that may lead to blockage of or damage to the ECCS sump. These inspections assure that the containment and sump are in the "as licensed" state of cleanliness prior to each reactor startup. Debris resulting from maintenance performed during normal operation will be carefully collected and removed from containment as part of standard operating procedures.

The sump inspection program includes an examination of sump structures, such as intakes and strainers, as outlined in Regulatory Guide 1.82 (R0).

6.2.2.5 Instrument Requirements

The instrumentation and controls associated with automatic initiation of the CSS and CCS during an accident are designed in accordance with IEEE 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations." Instrumentation and controls provide the operator with information for monitoring all modes of operation. "RUN" and "STOP" indication is provided for each spray pump motors, including "CLOSE" and "OPEN" position indication for each isolation valve. "RUN FAST", "RUN SLOW" and "STOP" indication is provided for each cooling fan.

Containment spray is automatically initiated by the CSAS. Each one of the redundant containment spray trains is started by the redundant CSAS generated by a coincidence of the SIAS and the high-high containment pressure signal, as described in Section 7.3. The system is initiated by starting the pumps and by opening the isolation valves FCV-07-1A and FCV-07-1B at the same time. Manual control of the system can be done from the control room.

The recirculation mode of operation is automatically initiated by a recirculation actuation signal as described in Section 7.3.

The containment fan coolers are normally started manually from the control room where the operator selects three out of four units to run at the higher of the two fan speeds during normal operation. As discussed in Subsection 9.4.8.4.1, three out of four Containment Fan Coolers are required to maintain reactor supports within design limitation. Four-position "STOP-AUTO-START-TEST" control switches are provided for each fan at the HVAC control board, in the control room. "TEST" positions of the control switch permits testing or running the fans at the low speed.

Component cooling water flows through all four cooling coils. Table 6.2-45 provides a list of Containment Heat Removal System instrumentation application. Table 6.2-46 shows the alarms which are not associated with any indicator or recorder but provides information to the operator, e.g., motor overload, valve fails to close or open etc.

6.2.3 SECONDARY CONTAINMENT FUNCTIONAL DESIGN

The secondary containment systems consist of (a) a secondary concrete enclosure (i.e., Shield Building) which surrounds the primary containment vessel and (b) a Shield Building Ventilation System (SBVS).

6.2.3.1 Design Bases

The design bases of secondary containment systems are to:

a. limit the pressure rise in the Shield Building annulus following a LOCA so as not to exceed the Shield Building internal design pressure, assuming a single active failure, and controlling and collecting leakage from the containment penetrations;

b. establish and maintain a subatmosphereic pressure in the Shield Building annulus following LOCA, assuming a single active failure, and to resist the maximum potential for exfiltration under all wind loading conditions characteristic of the site;

c. provide means of reducing offsite doses resulting from post accident leakage by evacuating air from the annulus and routing through the SBVS filtration units, assuming a single active failure;

d. provide fission product removal capability based on guidelines established for design basis accidents, a containment vessel design leak rate of 0.5 volume percent per day for the first 24 hours and 0.25 volume percent per day thereafter;

e. withstand safe shutdown earthquake loads and external/internal pressure differential of three psi without loss of function;

f. withstand post-accident environmental conditions within the Shield Building without loss of function;

g. provide means of reducing offsite doses by providing fission product removal capability while evacuating air from the Fuel Handling Building as described in Subsection 9.4.2, assuming a single active failure; and

h. permit appropriate periodic inspection and periodic pressure and functional testing to assure system integrity and functional capability.

Additional design bases for the Shield Building are given in Subsection 3.8.4.1.1.

6.2.3.2 System Design

6.2.3.2.1 Shield Building

The Shield Building is designed as a seismic Category I structure and its design features are further described in Subsection 3.84. Plan and elevation drawings are provided in Section 1.2.

The design and performance data for the Shield Building is provided in Table 6.2-47. Industry codes and standards and Regulatory Guides applied in the design of the Shield Building are listed in Subsection 3.8.4.2.

The Containment Isolation System is discussed in Subsection 6.2.4 and isolation valve design features are described in Subsection 6.2.4.3. The penetration types are defined, and their design features are discussed in Subsection 3.8.2.

The containment isolation actuation signal which activates the isolation valves are listed in Table 6.2-53, where containment penetrations and their isolation valves are listed according to penetration types and isolation class.

The Shield Building design objectives include the establishment of an essentially leaktight barrier against uncontrolled release of radioactivity. The Shield Building provides the annular space to consolidate the primary containment outleakage, and the SBVS maintains a negative pressure inside the annulus and filters for removal of fission products, and thus prevents the

leakage from flowing directly from the annular space through the Shield Building structure to the atmosphere.

A fraction of the primary containment outleakage occurs through penetrations which includes isolation valves, seals, gaskets and welds as possible sources for potential bypass leakage paths. These penetrations pass through the primary containment steel vessel as well as the Shield Building and are identified as potential bypass leakage paths in Subsection 6.2.4.4.

An evaluation of potential bypass leakage paths considering realistic equipment design limitations and test sensitivities is provided in Subsection 6.2.4.3.

Isolation valves which are subject to potential leakage are tested according to "Type C" tests, and seals, gaskets and welds are tested according to "Type B" tests defined in Appendix J to 10 CFR 50. Tests of bypass leakage paths and for the determination of the bypass leakage fraction are provided in the Technical Specifications.

6.2.3.2.2 Shield Building Ventilation System

The Shield Building Ventilation System is shown on Figures 9.4-1 and 9.4-11 and consists of two full capacity redundant fan and filter subsystems which share a common Shield Building duct intake. Each filter subsystem consists of an electric heater, demisters, electric heater, HEPA prefilter, charcoal adsorber and HEPA afterfilters enclosed in a common casing. Each of these components are discussed in Subsection 6.5.1.

Table 6.2-48 contains the design data and materials of construction for Shield Building Ventilation System components, including charcoal filters. Subsection 6.5.1 contains a comparison of the Shield Building Ventilation System design to Regulatory Guide 1.52 requirements. The SBVS fan performance curve is shown on Figure 6.2-52.

The Shield Building Ventilation System annulus air intake consists of a ring duct with inlets at approximate Elevation 62 ft. located in each quadrant and at the top of the Shield Building. Two separate 30 inch diameter lines from the ring duct penetrate the Shield Building walls to connect to their corresponding filter subsystems. The fan and filter subsystems are located in the Reactor Auxiliary Building (Elevation 43 ft). Outside air lines, 26 x 26 inches and each isolated by a check valve and a motor operated butterfly valve in series, are connected to the intake of the filter subsystems to provide cooling air to the filters when required. A 12 inch line with an isolating butterfly valve cross connects the filter subsystems downstream of the filter hanks and upstream of the fans to maintain flow through the inoperative filters in the event of failure of a fan. A gravity damper is located at the discharge of each fan to prevent loss of capacity of an operating fan due to recirculation through an inactive subsystem.

Following a LOCA, the resultant pressure and temperature expansion of the containment vessel and the heat transfer through the vessel walls cause a decrease in the Shield Building volume and an increase in pressure. The annulus pressure is rapidly drawn down by operation of the Shield Building Ventilation System. The motorized dampers downstream of the fans are normally open. Upon receipt of a CIAS, the fans are in full operation in 10 seconds assuming offsite power is available. In the case of a loss of offsite power, the fans receive a CIAS to start but are not actuated until they are loaded on to the diesel generators. Therefore, assuming a coincident loss of offsite power, the fans are in full operation in approximately 26 seconds after start of the diesel generators. The Shield Building annulus pressure transient analysis, provided in Subsection 6.2.3.3.1, assumes that following a postulated LOCA, there is a free venting

period followed by fan start-up. Once in full operation, the fan initial exhaust rate is approximately 7500 cfm. Within 310 sec. after a LOCA, the Shield Building annulus pressure is below atmospheric. The fan continues exhausting at a decreasing rate until the pressure in the Shield Building is two in. wg negative with respect to atmospheric as sensed by a pressure differential transmitter. At this point, the motorized damper at the discharge of the fan closes to a preset position to throttle air flow to the continuous rated system flow of 6000 cfm. As the Shield Building annulus becomes evacuated and the heat transfer rate from the containment stabilizes, the amount of outflow from the annulus is essentially balanced by the Shield Building inleakage. At a differential pressure of 1.75 in. wg negative, the amount of inleakage is less than 100 cfm. In order to provide adequate cooling air flow through the filters, additional air is taken from the outside atmosphere through a makeup cooling air line located outside the annulus upstream of the filter train. The outside air makeup line motor operated butterfly valve is opened automatically when the annulus differential pressure reaches one inch wg negative. The check valve in the cooling line is designed to have a pressure drop of not more than 3.0 inch wg and to open at 1.0 inch wg negative to provide vacuum control in the system and to allow outside air to cool the filters.

The SBVS is also interconnected to the spent fuel pool area exhaust duct. Upon receipt of a high radiation signal in the fuel pool area, the exhaust air is directed to the SBVS filtration units. The motor operated butterfly valves FCV-25-30 and 31 open and the exhaust fans start automatically. Motor operated valves FCV-25-32 and 33 close to isolate the annulus. Although a fuel handling accident inside the FHB concurrent with a LOCA is not considered a design basis event, a CIAS overrides the Fuel Handling Building high radiation signal and initiates the depressurization of the Shield Building annulus. The Fuel Handling Building Ventilation System is further discussed in Subsection 9.4.2.

Each of the SBVS intake trains is also connected to the Continuous Containment/Hydrogen Purge System. This connection, manually initiated from the control room, provides hydrogen purge capability while minimizing offsite radiological consequences. The Continuous Containment/Hydrogen Purge System description is provided in Subsection 9.4.8.8.

Both SBVS subsystems are automatically started by a CIAS or high radiation signal from the Fuel Handling Building. One can be manually shut down and placed in the standby mode. The standby subsystem automatically restarts if the operating subsystem should fall. The cross connection valve is opened from the control room to assure air flow through the failed system. Detectors in the charcoal beds annunciate temperatures exceeding 200°F.

The design basis review to determine the maximum expected differential pressure has been completed for motor-operated butterfly valves FCV-25-32 and FCV-25-33 in response to NRC Generic Letter 89-10, Safety-Related Motor-Operated Valve Testing and Surveillance. FCV-25-29 and FCV-25-34 were removed from the GL 89-10 program.

6.2.3.3 Design Evaluation

6.2.3.3.1 Performance Requirements and Capabilities

Each of the two full capacity fan-filter trains of the Shield Building Ventilation System, along with the Shield Building, are designed to fulfill the performance requirements stated in the design bases in Subsection 6.2.3.1.

As a part of the original plant design bases, the analysis of the functional capability of the SBVS to depressurize and maintain a uniform negative pressure within the Shield Building annulus was performed for the 9.82 square foot double ended suction leg slot break LOCA using the WATEMPT computer code described in Appendix 6.2B (Historical). For the EPU condition, computer code GOTHIC is used to determine whether the SBVS meets the design criteria for the limiting LOCA case (DEHLS break, min SI, 1 CS, 2 CFCs). The description of the development of the pipe break mass and energy release rate and the containment initial conditions are contained in Subsection 6.2.1. Any additional initial conditions or changes from those listed in Subsection 6.2.1 are contained in Table 6.2-49.

Assumptions used in the analysis include the following:

a. Credit is not taken for heat transfer from the secondary containment structure to the environs.

b. Secondary containment leakage is considered into and out of the Shield Building.

As shown on Figure 3.8-9, containment penetrations for the Containment Purge System (P-10 and P-11) each contain a 3/4 inch bleed-off into the Shield Building annulus. The purpose of these bleed-offs is that after an accident inside containment that results in pressurization and subsequent containment isolation, any valve seat leakage through the first two isolation valves (see Figure 9.4-9) bleed-off to the annulus volume and protect the penetration assembly through the concrete Shield Building from exceeding its design pressure. Due to the limited amount of expected valve seat leakage (284 cc/hr at 45 psig for both valves) and the small size of these bleed-off openings, this leakage contribution is considered insignificant and therefore not factored into the annulus pressure transient analysis. Even considering a single active failure of the outboard isolation valve to close, the leakage from the outside environs through one 3/4 inch bleed-off as a result of a differential pressure (atmosphere and negative pressure in the annulus) is insignificant.

Following the postulated LOCA, the annulus is quickly pressurized due to the volume reduction resulting from the sudden expansion of the containment vessel caused by the pressure and temperature transient resulting from the blowdown. The annulus is further pressurized as the gases within the annulus are gradually heated up due to convection and radiation heat transfer through the steel wall of the containment vessel.

The containment pressurization, heating, and subsequent volume expansion was not implicitly modeled for the EPU assessment. Instead, the limiting LOCA EPU containment pressure and temperature profiles were treated as boundary conditions and the annulus volume reduction effect due to containment volume expansion was explicitly modeled based on the peak pre-EPU containment pressure for the DESLS break shown in Figure 6.2-53 (historical data). The annulus volume expansion effect is also explicitly modeled, based on the EPU containment pressure and temperature for the limiting LOCA case (DEHLS break, min SI, 1 CS, 2 CFCs).

The 4 times Tagami heat transfer coefficient from the containment vapor space to the vessel surfaces is applied. This approach is conservative since the containment pressure and temperature profiles calculated for the containment analysis are applied as boundary condition for the annulus pressurization. In reality, the containment pressure and temperature will be significantly decreased if the maximum Tagami condensation heat transfer coefficient is increased by 4 times. The containment vessel (steel) is heated up mainly due to the condensing heat transfer from the containment vapor space to the vessel surfaces.

Radiation heat transfer via the steel containment vessel to the annulus gas space and to the shield building concrete wall and ceiling were considered in the analysis. Natural convective heat transfer was also applied between the containment vessel outer surface and the annulus gas space, and between the annulus gas space and the shield building concrete wall and the inner surfaces of the ceiling. Heat transfer due to conduction within the containment vessel and the shield building concrete wall and ceiling was also considered.

The shield building ventilation system (SBVS) fan flow rate transient used in this analysis was conservatively based on fan performance assuming operation of the emergency diesel generator at 1% under frequency conditions.

The analysis results are as follows:

a. Pre-EPU containment pressure and temperature as function of time (Figures 6.2-53 and 56) (Historical)

b. Annulus pressure and temperature as function of time (Figures 6.2-54 and 56A)

c. Condensing Heat Transfer Coefficient as a function of time (Figure 6.2-57)

d. SBVS purge flow rate as a function of fan static pressure (Figure 6.2-52)

From the results above, it is demonstrated that each of the Shield Building Ventilation System centrifugal fans is adequately designed to independently decrease annulus pressure to slightly subatmospheric after a LOCA. Due to the subatmospheric annulus pressure the post-accident activity release from the containment vessel is routed through the filter train provided and not through the Shield Building as leakage.

Air flow due to wind around and over a building creates regions in which the static pressure is either above or below the static pressure in the undisturbed air stream. In general, pressures are positive on the windward side and negative on the leeward side. Pressures on the remaining sides may be negative or positive depending on the angle of the wind. The velocity head equivalent to a given wind speed can be expressed as: (17)

$$P_2 = 0.000482\ V^2_w$$

Where P_2 = Velocity Head, inch wg

V_w = Wind Velocity, mph

As indicated in Table 2.3-11, the maximum daily average windspeed at the St. Lucie Site is 18 mph (8.1 m/sec). The corresponding velocity head is calculated to be -0.156 inch wg. According to Reference 17, surfaces when curved may act as airfoils, resulting in negative pressures two or more times the velocity head of the free air stream. Since the Shield Building is a curved surface, the velocity head can be assumed to be -0.468 inch wg. Since the Shield Building annulus is maintained at -2.0 inch wg., no exfiltration is expected through the concrete wall.

The SBVS heaters have the capacity to reduce air from 100 percent to 70 percent humidity at a 6000 cfm flow rate. Each moisture separator demister has an efficiency of 99 percent when exposed to entrained water particles of one to five microns in size. The 12 HEPA filters per train have an efficiency of at least 99.97 percent when tested with 0.3 micron dioctylphthalate (DOP)

smoke. HEPA filter assemblies are constructed of materials capable of withstanding a temperature of 200°F. The charcoal adsorbers are potassium iodine (KI) impregnated and have the radioiodine removal efficiency of 99 percent minimum in accordance with ANSI N509-1976. The relative humidity of air entering the charcoal adsorber is below 70 percent because each filter train is provided with a 30 kw electric heating coil to assure that the relative humidity remains below 70 percent. A second heater is provided, with power from an alternate source should power to a train be lost, to assure 70 percent humidity of the cooling air, for removal of decay heat.

The amount of decay heat (refer to Figure 6.2-60) is very small when compared to the mass and large surface area of the charcoal adsorber and filter housing. Convection and conduction to ambient atmosphere can easily remove this decay heat without any cooling air. To enhance the removal of decay heat, cooling air is allowed to pass through the inoperative filter train. Figure 6.2-61 shows the charcoal temperature as a function of cooling air flow.

An evaluation was performed to determine the impact of the Extended Power Uprate (EPU) with regard to decay heat generation and dissipation. The above analysis identifies that the amount of decay heat is small when compared to the mass and large surface area of the charcoal adsorber and filter housing. UFSAR Figure 6.2-61 shows the charcoal temperature as a function of cooling air flow (no heat transfer assumed through the housing) and it is shown that with a flow rate as low as 100 cfm the temperature rise of the air at the time of maximum decay heat following a DBA would be 25°F at the minimum design flow rate of 300 cfm the temperature rise would only be approximately 8°F.

The existing margin between the currently predicted heat rise at a minimum cooling flow of 300 cfm (i.e., -8°F) and the alarm setpoint of 200°F is more than sufficient to accommodate the extended power uprate and the change in source terms from TID-14844 to alternate source term (AST). The application of AST reduced iodine inventory and associated heat load in the charcoal filters to less than that predicted to have been accumulated in the TID-14844 design basis analysis. Although the extended power uprate will increase the source term, the resulting iodine inventory and associated heat load in the charcoal filters will still remain below the design basis TID-14844 values.

The heat contribution to the charcoal media due gamma heating resulting from the particulate inventory accumulated in the HEPA filters is not significant since the associated gamma heating rate in the charcoal is less than that generated by the iodine in the charcoal during the first 30 days following the DBA when the decay heat rate is the highest.

Each filter train is monitored for temperature by redundant sensors as indicated in Subsection 6.2.3.5. Since charcoal adsorber temperature is alarmed and recorded in the control room and, since capability exists for utilizing the redundant filter train, and since cooling air is available for the shutdown filter train, even when any single active failure is assumed, the charcoal filter train temperature does not approach the desorption or combustion temperature. Thus, the SBVS design provides satisfactory cooling of the adsorber beds. The filter bed loading for a fuel handling accident would be less severe than for the above analysis.

6.2.3.3.2 Single Failure Analysis

Two redundant subsystems are provided, either of which is capable of meeting the requirements of the system design bases. Each subsystem is actuated by a separate CIAS actuation channel. As explained in Section 8.3, all redundant active components are powered

from separate emergency bases. Consequently, the Shield Building Ventilation System design function is not compromised by any single failure. A failure mode and effect analyses is shown in Table 6.2-50.

An analysis is conducted to determine if a single active failure could result in an air flow through a recently shutdown filter train of less than the flow required to maintain a 200°F adsorber temperature. For any single active failure, a system air flow balance indicates that in the worst case at least 300 cfm of cooling air is drawn through the he inoperative train by means of a cross- connection to the remaining fan/ filter train. Assuming failure of the operating train of the Shield Building Ventilation System, train A for example, approximately 5700 cfm of air would be drawn through the train B air intake when the train B fan is automatically actuated. Of the 6000 cfm, a system air balance analysis demonstrates that approximately 300 cfm is drawn through the inoperable train A filters. This is accomplished by the normally open (control room operated) cross-connect valve (FCV-25-13) and ductwork which is located downstream of the filters and upstream of the fans. The cooling air from train A then joins the train B air stream prior to discharge by fan HVE-6B.

Therefore, the analysis shows that adequate air flow is available for filter cooling even when the minimum cooing flow requirements are based on upper limit calculations. Also a small heater, provided in the stand-by train, is powered from an operating train power source to assure humidity control of the cooling air in the stand-by train.

The single failure criterion is not applied to HVAC ductwork serving redundant safety related equipment. No ductwork operates at pressures greater than 22 inch wg (about 3/4 psi) so that rupture of the ductwork could not occur due to the pressure of the contained gases.

Common ductwork serving safety related equipment occurs at the following,:

a. Duct which cross-connects the two SPVS filter trains,

b. Annulus ring duct,

c. Exhaust riser from the top of dome connecting the two intake ring headers, and

d. Ductwork that connects fans to plant vent

In each case the ducting is located in areas where there is no high pressure piping that could result in pipe whip or jet impingement. Similarly the ducting is not located in areas where internally generated missiles or failure of non-seismic structures or components could affect system operation. Leakage from cracks in the ductwork do not prevent the vent system from performing its safety function. There is no high energy pipes that run inside the Shield Building annulus. All high energy piping passing through both the primary containment vessel and the Shield Building wall is provided with guard pipes.

6.2.3.4 Tests and Inspections

An overall system performance test of the Shield Building and SBVS is described in Section 14.0.

Periodic integrated functional testing of the Shield Building/SBVS and FHB/SBVS are performed in accordance with the Technical Specifications. Periodic testing of HVAC isolation valve operability is also performed.

Testing of the SBVS fans and filters is discussed in Subsection 6.5.1.

6.2.3.5 Instrumentation Requirements

Each redundant SBVS is provided with instrument and controls designed for proper functioning of SBVS in order to meet the requirement stated in the design basis in Subsection 6.2.3.1. The application of instrumentation is shown in Table 6.2-51.

A CIAS or high radiation signal from the FHB starts both exhaust fans HVE-6A and 6B. (The SBVS response for high radiation in the FHB is further discussed in Subsection 9.4.2.) Upon receipt of one in. wg. in negative differential pressure signal from annulus (PDS-25-7A & 7B) the outside cooling air inlet valves (FCV-25-11 and 12) automatically open. Normally the exhaust fan dampers (D-23 and D-24) are open. Upon receipt of two in. wg. negative differential pressure signal from PDS-25-7A, 7B the dampers partially close to reduce the air flow. Each damper is also controlled by the exhaust air flow, through a flow transmitter and controller (FT-25-20 and FIC-25-20, respectively). Air flow below the normal set point increases the opening of the damper. Air flow above the set point reduces the opening of the damper. Hence the air flow is maintained at preset value.

Operator intervention is required to place one train on a standby mode when both trains are started automatically. The standby fan is restarted automatically by a low flow signal from the discharger line of the operating fan.

The 30 kW electric heater is interlocked with the fan of the same filter train. The 1.5 kW electric heater is interlocked with the other fan to limit relative humidity of cooling air to a maximum of 70 percent for decay heat removal).

6.2.4 CONTAINMENT ISOLATION SYSTEM

The containment isolation system provides the means of isolating fluid systems that pass through containment penetrations such that any radioactivity that may be released into the containment atmosphere following a postulated design basis accident (DBA) is confined. There is no one particular system for complete containment isolation, but isolation design is provided applying acceptance criteria common to penetrations in many different fluid systems.

6.2.4.1 Design Bases

The design bases governing the containment isolation system are discussed below.

The containment isolation valves are designated seismic Category I and designed to ASME Code, Section III and Quality Croup B requirements. Containment isolation valves are designed to ensure leak-tightness and reliability of operation. Containment isolation globe, check and gate valves meet the requirements of manufacturers standards MSS-SP-61, "Hydrostatic Testing of Steel Valves," and containment isolation butterfly valves meet the requirements of manufacturers standards MSS-SP-67, "Butterfly Valves."

6.2.4.1.1 Conditions Requiring Containment Isolation

a. Automatic initiation of a containment isolation actuation signal (CIAS) occurs when a high containment pressure setpoint or a high containment radiation level setpoint is detected, or when a Safety Injection Actuation Signal is initiated. This provides diversity of parameters sensed for the initiation of containment isolation.

b. The CIAS closes fluid line penetration isolation valves not required for operation of the Engineered Safety Features.

c. The containment isolation system is designed such that no single active failure (in conjunction with loss of offsite power) could result in offsite doses or doses to operators in the control room in excess of guidelines established for design basis accidents.

d. The main steam and feedwater valves close on MSIS and the valves for the component cooling water for the reactor coolant pump motors close on SIAS (see Section 7.3 and Subsection 6.2.4.3.2).

6.2.4.1.2 Criteria for Isolation of Fluid System Penetrating the Containment

a. The containment isolation provisions for the fluid system penetrations (excluding the ESF systems) are designed in accordance with General Design Criteria 54, 55, 56 and 57 (refer to Table 6.2-52). Exceptions to GDC provisions are discussed in Subsection 6.2.4.3.

b. Containment isolation valves on lines serving engineered safety feature systems are not closed automatically by the CIAS, may be closed by remote manual operation from the control room.

c. The piping penetration assemblies are designed to withstand at least a pressure and temperature equal to the containment vessel design internal pressure and temperature and to withstand the post accident transient environment. Two barriers are provided between the containment atmosphere and the outside atmosphere, so that failure of one valve to close does not prevent isolation. The design of containment penetrations accommodate thermal pressurization concerns due to environmental heating of trapped fluids (Reference NRC Generic Letter 96-06).

6.2.4.1.3 Criteria for Isolation of Fluid Instrument Lines

The containment isolation provision for the fluid system instrument line penetrating the containment conform to the Regulatory Guide 1.11, "Instrument Lines Penetrating Primary Reactor Containment," March 1971 (R0). The instrument tubing and containment penetrations 45 and 53 are designed to be ASME Class 2; the shield building penetrations 45B and 53B are designed to be ASME Class 3.

6.2.4.1.4 Design Requirement for Containment Isolation Barrier

a. Penetration assemblies and containment isolation valves are designed as seismic Category I in accordance with Regulatory Guide 1.29, "Seismic Design Classification," February, 1976 (R2) and are designed to Quality Group B in

accordance with Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," February, 1976 (R3) as delineated in Section 3.2.

b. Provisions for Type B and C leak testing of the penetrations are provided utilizing the guidance of 10 CFR 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors," and/or Appendix J, Option B performance based requirements.

c. Containment isolation valves are designed to ensure leak tightness in accordance with manufacturer standards (see Subsection 6.2.4.3).

d. The containment isolation system is able to perform its design function following any natural phenomenon.

e. The containment isolation system is designed to withstand pipe rupture effects.

6.2.4.2 System Design

Table 6.2-52 provides the design information regarding the containment isolation provisions for the fluid system lines and fluid instrument lines penetrating the containment.

Fluid lines penetrating the containment are classified according to their function during normal and post-accident operation. Various combinations of valving and pressure boundary barriers are used to establish isolation of each penetration class. The penetration classes correspond to GDC 55, 56 and 57 and Regulatory Guide 1.11 (R0). In each of the penetration classes at least two barriers are provided between the containment atmosphere and the outside atmosphere so that no single failure can prevent containment isolation. The explicit mode of compliance with these requirements is illustrated below:

a. <u>GDC 56 "Primary Containment Isolation"</u>

GDC 56 delineates containment isolation provisions for lines that connect directly to the containment atmosphere and penetrate containment vessel. The St. Lucie Unit 2 design complies with GDC 56 as follows:

Penetrations in Class A1 are for lines through which fluid normally flows or may flow during power operation, which are not connected to the reactor coolant pressure boundary (RCPB), and are either:

1. open directly to the containment atmosphere and connected to non-seismic piping or duct work outside the containment; or

2. connected to non-seismic piping on both sides of the containment.

These lines have two isolation valves in series, one located inside and one located outside containment, which close automatically when containment isolation is required. Check valves are considered automatic only when located inside containment. Class A1 valves except check valves can be closed from the control room.

Class A2

Penetrations in Class A2 are for lines which are normally closed and not opened during power operation, which are not connected to the reactor coolant pressure boundary, and are either:

1. open directly to the containment atmosphere and connected to non-seismic piping outside the containment; or

2. connected to non-seismic piping on both sides of the containment

Class A2 Lines are provided with either:

1. two manual isolation valves (normally closed) in series; or

2. one manual isolation valve (normally closed) and one blind flange in series; or

3. one manual isolation valve (normally closed) and check valve in series

4. two automatic isolation valves in series.

In each of the above cases, one isolation valve is located inside containment and one isolation valve is located outside containment. A check valve is considered as an automatic isolation valve only when located inside containment.

A lock is provided on each normally closed valve and administrative procedures ensure that the valve is not left open after maintenance or inadvertently opened during power operation.

b. GDC 55 "Reactor Coolant Pressure Boundary Penetrating Containment"

GDC 55 provides containment isolation provisions for lines that are part of the RCPB and that penetrates primary reactor containment. The design complies with GDC 55 as follows:

Class B1

Penetrations in this class are for lines which are connected to the Reactor Coolant System and through which fluid normally flows or may flow during power operation. Two valves in series, one located inside and one located outside containment, are provided which close automatically when containment isolation is required. Class B1 valves, except check valves also can be closed from the control room. The charging line (penetration 27) is discussed in Subsection 6.2.4.3.

Class B2

Penetrations in this class are for lines which are connected to the Reactor Coolant System and are normally closed during power operation. These lines have two manual valves or two valves capable of remote manual operation in series, one located inside and one located outside containment, which are provided with locks to ensure that a valve is not left open after maintenance or inadvertently opened during power operation.

c. GDC 57 "Closed System Isolation Valves"

GDC 57 provides containment isolation provisions for lines that penetrate the containment vessel and are neither part of the RCPB nor connected directly to the containment atmosphere. The design complies with the requirements of GDC 57 as follows:

Class C

Penetrations in this class are for lines which are neither connected to the Reactor Coolant System nor open to the containment atmosphere but connected to a closed seismic Category I system inside containment. These lines are provided with at least one containment isolation valve outside the containment which is either manual locked closed, automatic, or capable of remote manual operation.

d. Regulatory Guide 1.11, "Instrument Lines Penetrating Primary Reactor Containment (R0)"

Regulatory Guide 1.11 (R0) specifies containment isolation provisions for fluid instrument lines penetrating primary containment. The design conforms to requirements of Regulatory Guide 1.11 (R0) as follows:

Class D

Penetrations in this class are for fluid instrument sensing lines that are connected to the Reactor Coolant System or connected directly to the containment atmosphere. These lines are provided with one isolation valve capable of automatic or remote manual operation located outside the containment and as close to the containment as practical. A self actuated excess flow check valve is considered an automatically actuated valve.

Fluid instrument lines penetrating the containment are in complete conformance with Regulatory Guide 1.11 (R0) and are isolated by means of a self actuated excess flow check valve or one remote manual valve located outside containment.

e. Systems Performing an ESF Function

Class E

Penetrations in this class are for lines that are designed to be open following a DBA to mitigate the effect of the accident. These lines are provided with either (1) automatic valve located inside containment in series with one remote manually actuated valve or (2) one remote manually actuated valve or one check valve located inside containment and a remote manual valve located outside containment.

The only line that utilizes only one isolation valve outside containment and no isolation valve inside is the containment sump suction (Penetrations 32 and 33). It should be noted that the reliability of this system is increased with this arrangement. Further the system is closed outside containment and any single active failure can be accommodated. The closed system outside containment is seismic Category I, Quality Group B and has a design temperature and pressure rating greater than that

of the containment. The outside line is always maintained full of water and hence no leak testing is required.

The emergency sump suction penetrations process lines are enclosed in a leak-tight housing, (i.e., carbon steel guard pipes) which extend from the sump inside containment to the Containment Isolation Valve located outside containment. Each guard pipe is directly welded to a steel containment vessel nozzle and acts as an extension of the containment in both directions. Passing through each guard pipe is the stainless steel sump suction line. These lines are welded to the guard pipe in the sump so that water cannot enter the annulus formed by the concentric pipes. Outside containment the suction lines are sealed to the guard pipes by means of a stainless steel bellows to allow for thermal movement. Figure 3.8-6 provides a detailed description of this type IV penetrations. The containment isolation valves are located in the Reactor Auxiliary Building pipe tunnel which is a controlled leakage area. Leakages from these systems are directed to the ECCS room sump which is provided with safety grade, seismic Category I level indications. A backup seismic Category I level indicator is also provided in each ECCS room sump to alert the operator of any abnormal condition. The ECCS area is also provided with two safety-related radiation monitors to measure the airborne effluent. A description of these monitors is provided in Subsection 11.5.2.2.10.

6.2.4.2.1 System Design Requirements

Design requirements for the containment isolation barriers are imposed as follows:

a. Containment isolation valve closure times are selected to assure rapid closure of the containment following postulated accidents.

   Valve closure times for all containment isolation valves are provided in Table 6.2-53.

b. The containment isolation valves are designed in compliance with Regulatory Guides 1.26 (R3) and 1.29 (R2).

c. Containment isolation valves, actuators and controls are located in areas which are enclosed. These penetration area enclosures are also designed to withstand the missiles postulated in Section 3.5. The piping in the penetration area is designed such that the failure of any pipe will not cause pipe whip damage to other piping nearby. This design concept assures that the failure of a nonseismic pipe will not result in loss of containment isolation. Under accident conditions the penetration area is continuously vented by the Emergency Core Cooling Area Ventilation System (Subsection 9.4.3) such that the service operating environment will not be detrimental to the equipment. Isolation valves are located above the maximum water level in the containment thereby preventing flooding and any debris from inhibiting the isolation function of the valve. The only exception is valve V6341 Reactor Drain Tank (RDT) Isolation Valve. This valve is located in the RDT pit and will be submerged during a LOCA. The operability of this valve has been analyzed and it has been determined that its containment isolation capabilities will not be compromised by being submerged.

   The fuel transfer tube has a double gasketed blind flange on the containment side permitting pressure leak testing between the gaskets, and a gate valve at the end

inside the Fuel Handling Building. The transfer tube and attachments are designed to withstand the forces resulting from the safe shutdown earthquake. The double gasketed blind flange serves as the primary containment seal.

d. In general, the design utilizes air-operated "fail-safe" containment isolation valves. There are also active automatically actuated isolation valves located inside the containment which are required to perform an isolation function in the event of a DBA. A list of active valves is provided in Subsection 3.9.3. Assurance of the operability of the valve is discussed in Subsection 3.9.3.

e. The main function of containment isolation is to minimize the radiological offsite doses. Therefore, the main qualification of a valve as an isolation barrier is its leak prevention capabilities. Applicable containment isolation valves are designed and factory tested so that the maximum allowable leakage does not exceed 10 cc of water per hour per inch of nominal valve diameter when subjected to containment maximum internal pressure (see Subsection 6.2.4.3).

   Leakage testing of isolation valves is described in Subsection 6.2.6. Design provisions are provided to perform the required 10 CFR 50 Appendix J and/or Appendix J, Option B, Type C, containment isolation valve testing. The system schematic drawings depicting the various design provisions for leak testing of the containment isolation valves are provided in Subsection 6.2.6.

   Specific information on isolation valve testing, bypass leakage, penetration testing and acceptance criteria is presented in Subsection 6.2.6.

f. Wherever two automatic isolation valves are in series, each valve operator is actuated from a separate and redundant CIAS channel, A or B, with power supplied to each valve from a separate emergency bus, A or B, as explained in Section 8.3. Table 6.2-53 lists the CIAS actuation channel for redundant isolation valves.

   Valves isolating penetrations serving engineered safety features systems will not automatically close with the CIAS, but can be closed by remote manual operation from the control room to isolate any engineered safety features system that may malfunction.

g. Secondary mode of operation of isolation valves required to change position upon initiation of CIAS are listed in Table 6.2-53.

h. Fluid systems that have a post-accident safety function are provided with remote-manual switches in the control room. Flow measuring devices and other instrumentation are provided for the operator to know when to isolate the fluid system. The ESF instrumentation and display are discussed in Sections 7.3 and 7.5 respectively.

   The Engineered Safety Features' areas are provided with sumps and corresponding pumps which are automatically initiated on high water levels with annunciations in the control room. This design feature provides the operator with the information required to isolate an ESF train should leakage occur.

i. The containment isolation penetrations that utilize water filled seal systems are: containment sump suction (Penetrations 32 and 33) containment spray (Penetrations 34 and 35), safety injection (Penetrations 36 to 39), shutdown cooling (Penetrations 40 and 64) and hot leg injection (Penetrations 69 and 70). These systems form closed seismic Category I systems outside containment and perform ESF functions post LOCA. They are designed to Quality Group B requirements and are protected from the dynamic effects of pipe rupture to ensure a fluid seal under all conditions. The closed systems inside the containment are designed as seismic Category I and Quality Group B and are considered as an extension of the containment. These penetrations are not subjected to type C or bypass leakage testing.

j. The environmental qualification tests for mechanical and electrical components exposed to accident environment inside the containment are described in Section 3.11.

6.2.4.3 Design Evaluation

As indicated in Table 6.2-52 the systems conforming to GDCs 55 and 56 are provided with two containment isolation valves, one inside and the other outside the containment. The containment penetrations which are required to close after an accident are provided with automatic isolation valves which close on CIAS. Whenever two automatic isolation valves are in series, as shown in Table 6.2-53, each valve operator is actuated from a separate and redundant CIAS channel, with power supplied to each valve from a separate safety-related bus, as explained in Section 8.3. This arrangement ensures containment isolation in the event of a single electrical failure.

The GDC 57 penetrations as depicted in Tables 6.2-52 and 53 are provided with at least one isolation valve outside the containment. A single outside valve does not jeopardize the containment isolation because the system inside the containment is closed, seismic Category I, Quality Group B and is considered as an extension of the containment.

Various systems perform post-accident functions and thus the valving arrangement must permit flow to the required areas (e.g., reactor, containment; etc). These penetration provisions are consistent with NRC guidelines in that they provide for the safe shutdown of the plant and aid to mitigate the consequences of an accident. The containment isolation provisions for lines required for post-accident or ESF related systems are as follows:

1. One automatic valve inside containment and one remote-manual valve outside containment. The systems that utilize this concept are:

   a. Containment Spray System - Penetrations 34 and 35

   b. Safety Injection System -Penetrations 36 to 39

   To comply with a regulatory staff request, the following isolation valve changes are made:

   Penetration 27 (chemical and volume control) - a check valve is added inside containment in line 2-CH-331 (charging line) as close to the containment as practicable.

Penetration 36 to 39 (safety injection) - Check valves are added in these lines inside the containment as close as practicable to the containment boundary.

2. One remote-manual valve inside the containment and one remote-manual valve outside containment.

   The only ESF system that utilizes this concept is the H2 sample system (Penetrations 48 and 51).

The isolation valves which are required to close after an accident are designed with a rapid closure time as indicated in Table 6.2-53. The Continuous Containment/Hydrogen Purge System is designed with a rapid (5 seconds) isolation valve closure time.

Table 6.2-53 also indicates the primary and secondary modes of valve closure, shutdown, post accident valve position and the valve position and the valve failure position. A case by case evaluation of this table confirms that if the primary mode of closure fails the valve could still be closed, if required, with an acceptable time frame by the secondary mode of closure.

The component cooling water isolation valves (Penetrations 23 and 24) do not close on a CIAS but do not jeopardize containment isolation. The component cooling water isolation valves are closed by SIAS. Component cooling water to the reactor coolant pumps and motors and CEDM coolers is interrupted by closure of any one of these isolation valves and inadvertent loss of the cooling water would require plant shutdown. The use of the SIAS to close the isolation valves does not compromise containment isolation since the same containment pressure setpoint (3.5 psig) is used for generating the CIAS and SIAS and affords additional protection for the reactor coolant pumps since the high containment pressure also trips the reactor. Furthermore, at NRC request, a delayed reactor trip is installed which trips the reactor upon loss of CCW flow to the reactor coolant pumps as discussed in Subsection 9.2.2.

There are no lines carrying radioactive water outside the containment (except the ESF systems required post-LOCA) which could be open before an accident and which do not close on a CIAS (e.g., reactor coolant drain tank pump suction line closes on a CIAS).

The motor operated valves fail in the "as is" position. These valves assume the required status following a DBA; thus containment isolation is not affected if ac power is lost temporarily.

As a minimum, the containment isolation valves are designed and factory tested so that the maximum allowable leakage does not exceed 1/10 of a standard cubic feet of air per hour per inch of nominal valve diameter when subjected to containment maximum internal pressure. The offsite doses are discussed in Chapter 15. The surveillance requirements for containment isolation valves are a part of the Technical Specifications.

6.2.4.4 Tests and Inspections

The program for the initial and subsequent functional testing for both the 10 CFR 50, Appendix J, Type C valves and valves that qualify as a source of bypass leakage is provided in Subsection 6.2.6 and Chapter 14 (Note that Technical Specification, Amendment 88, allows Appendix J, Option B testing. This testing allows the licensee to establish intervals for leak-testing based on the performance history and risk significance of the components (containment, penetrations, and valves).

The Containment Leakage Rate Testing Program includes those penetration isolation valves considered as possible sources of bypass leakage and Type C testing. Isolation valves not considered as a possible source are listed below.

a) Penetrations that form a closed system inside containment in accordance with GDC 57 are not subject to bypass leakage or Type C testing. These systems are designed seismic Category I, Quality Group B systems inside containment and designed for a higher pressure than the containment design pressure. These systems are also protected from the dynamic effects of pipe rupture as outlined in Section 3.6. The penetrations that utilize this concept are as follows:

Penetrations	1,2	- Main Steam
	3,4	- Feedwater
	5,6	- Steam Generator Blowdown
	30,49	- Steam Generator Blowdown Sampling
	15-22	- CC Water to Containment Fan Coolers

During accident conditions, the Main Steam and Feedwater Isolation valves will close upon receipt of a MSIS (high containment pressure or low steam generator pressure) while the Steam Generator Blowdown and Blowdown Sampling Isolation valves will close upon receipt of a CIAS (high containment pressure or high containment radiation or SIAS). Figure 6.2-2a provides the containment pressure response for the worst break scenario and illustrates that the containment atmosphere rises to a peak of 43.43 psig and reduces to less than half the peak pressure within the first day post-accident. Therefore, the steam generator inventory that existed prior to the accident will be available post-accident and will act as a steam seal at the onset of the accident. Subsequent to the decay of the steam generator pressure and level, the Auxiliary Feedwater System will automatically maintain the steam generator level to guarantee the pressure of a water seal and thereby preclude bypass leakage.

b) Penetrations that are used post-accident or for ESF - related function are not subject to bypass leakage or type testing. These lines form a closed seismic Category I system outside containment. They are designed as seismic Category I, Quality Group B systems and are protected from the dynamic effects of the pipe rupture as outlined in Section 3.6.

These include:

Penetrations	32,33	- Containment Sump Suction
	34,35	- Containment Spray
	36-39	- Safety Injection
	40,64	- Shutdown Cooling
	69,70	- Hot leg injection

c) Various penetrations that are filtered by the Shield Building Ventilation System and thus are not subject to bypass leakage. The following valves follow this criteria:

Penetrations	10,11	- Containment Purge/Exhaust
	67,68	- Containment Vacuum Relief

d) The penetrations for the instrument sensing lines which are isolated in accordance with Regulatory Guide 1.11 (R0) are connected to a closed seismic Category I piping outside containment and, therefore, not subject to bypass leakage or Type C testing.

e) The charging line (Penetration 27) is not considered a credible source of bypass leakage following a LOCA. Charging Pumps 2A and 2B are automatically started following receipt of a Safety Injection Actuation Signal (SIAS) and are powered by the emergency diesel generators. Thus, after an accident flow is directed into containment through this penetration precluding bypass leakage by establishing a water seal. If the pumps were not operating radioactive contaminants are prevented from reaching the environment by a minimum of three seismically qualified, Safety Class 2 check valves in series. These design features virtually eliminate any possibility of bypass leakage.

The criteria determining for which penetration isolation valves bypass leakage could occur are:

a. a pressure or water seal could not be guaranteed.

b. the bypass leakage could not be guaranteed to exit in a leakage control area (i.e., Shield Building annulus, ECCS pump area or piping penetration tunnel).

c. the lines are connected to neither a closed seismic Category I system inside nor outside of containment.

The criteria for determining which containment isolation valves require Type C testing is as follows:

a. Lines that provide a direct connection between the inside and outside atmospheres of the primary reactor containment during normal operation.

b. Lines that are required to close automatically upon receipt of a CIAS.

c. Lines that are required to operate intermittently under post-accident operations.

Specific information on isolation valve testing, bypass leakage, penetration testing and acceptance criteria is presented in Subsection 6.2.6.

6.2.5 COMBUSTIBLE GAS CONTROL IN CONTAINMENT

Systems are provided in accordance with General Design Criterion 41 to control the concentration of hydrogen that may be released into containment following a LOCA. These systems are the containment hydrogen analyzers, the containment hydrogen recombiners and containment hydrogen purge.

The hydrogen build-up inside containment is controlled by the Containment Combustible Gas Control System. This system provides the capability to monitor and maintain hydrogen concentrations within safe limits after a LOCA and is made up of the following subsystems: containment hydrogen analyzers, containment hydrogen recombiners and containment hydrogen purge.

The stretch power impact on the post LOCA hydrogen build-up inside containment has been analyzed.

A number of changes have been incorporated into the current model, including an updated long-term temperature transient, increased radiolytic hydrogen due to the increased reactor power level, additional zinc-based paint, additional galvanized steel and additional aluminum ladders.

The analysis proved that the Containment Combustible Gas Control System is capable, without any modification, of preventing the hydrogen gas concentration inside containment from exceeding the lower flammability limit of four volume percent, which complies with the existing system design criteria.

6.2.5.1 Design Bases

The capability to uniformly mix the containment atmosphere and to prevent high concentration of combustible gases from forming locally is provided by:

a. forced circulation by the containment fan coolers and their associated ductwork

b. mixing of containment air by the Containment Spray System

c. the process of natural diffusion of combustible gas within the containment air as discussed in Subsection 6.2.5.3

The H_2 analyzers and H_2 recombiners comprise the redundant 100 percent capacity Combustible Gas Control System (CGCS). The design bases for these systems, which are Engineered Safety Features, are:

a. To permit the sampling and measurement of hydrogen concentration at several points within the containment, and annunciate in the control room if the hydrogen concentration is above three volume percent.

b. To prevent hydrogen gas concentration inside containment from exceeding the lower flammability limit of four volume percent.

c. To perform the above functions assuming a single failure.

d. To be designed to seismic Category I requirements and applicable Quality Group B criteria.

e. To withstand the dynamic affects associated with pipe rupture as discussed in Section 3.6.

f. To be operable when subjected to the post-accident environment as discussed in Section 3.11.

g. To provide for testing and inspection during normal plant operation.

The hydrogen recombiners are fixed systems inside the containment and there is no sharing of the Combustible Gas Control System between St. Lucie Units 1 and 2.

In addition to the redundant CGCS, the Continuous Containment Purge/hydrogen Purge System is available for fission product removal and hydrogen purge following a LOCA.

6.2.5.2 System Design

6.2.5.2.1 Containment Hydrogen Analyzer Subsystem

The Containment Hydrogen Analyzer System consists of two redundant subsystems as shown on Figure 12.3-14, consisting of the sample and return piping, associated valves, hydrogen analyzer, grab sample cylinder, sample pump, moisture separator, cooler, instruments, calibration gas line and reagent gas line.

Each of the redundant subsystems is physically separate and operates independently of the other, and is powered from an independent onsite power source. No single failure can result in a total loss of hydrogen concentration measurement capability. Failure of one train is annunciated in the control room.

Components of the system are accessible for periodic inspection and maintenance. The system is designed to permit remote calibration at periodic intervals with a reference hydrogen gas standard (span gas) and oxygen. The system is independent of any system used during normal plant operation so that plant operation does not impose restrictions on such testing.

The Hydrogen Analyzer System piping, from the sample points within the Containment and piping returning the sample to the Containment, up to and including all containment isolation valves, are designed and fabricated in accordance with ASME Section III Class 2 and N-stamped. The hydrogen analyzer package contains instrumentation elements which are inherently non-ASME, code items (e.g., flowmeters, pressure gages, and the analyzer element). Therefore, the hydrogen analyzer package is classified as a Class 1E instrument. Instrumentation, controls and electric equipment associated with the system will be Class 1E. Conformance to applicable IEEE Standards is discussed in Chapter 7.

The system is initiated by manual operator action from the control room. No action outside the control room is necessary for system operation.

Once initiated, the system draws a continuous air sample from one of the sample points inside containment. Sampling valves can be manually controlled to analyze any sample point. The air is passed through the detector, analyzed, and pumped back into containment. Analyzer readings are recorded in the control room, and an alarm is actuated if concentration is above three percent. Alarm is also provided for low flow and low temperature in the analyzer hot box. Design and performance date for the analyzer is listed in Table 6.2-54.

The system is designed and the components are qualified to operate under the applicable environmental conditions as described in Section 3.11.

The operating principle of the hydrogen analyzer is thermal conductivity of the sample. Air samples are drawn from any of the following sample points

a. Containment dome

b. Upper Containment

c. Pressurizer enclosure

d. Vicinity of reactor coolant pump (RCP) 2A1

e. Vicinity of reactor coolant pump 2A2

f. Vicinity of reactor coolant pump 2B1

g. Vicinity of reactor coolant pump 2B2

These points provide broad coverage of the containment for hydrogen monitoring and constitute a redundant independent H2 Sampling System. Sampling lines originating from the containment dome, pressurizer, RCP 2A1 and RCP 2A2 areas constitute one independent train of the H2 Sampling System. The other train consists of sampling lines originating from the upper containment, RCP 2B1 and RCP 2B2 areas. Each train of the sampling lines has a common header inside the containment and penetrates the containment in a separate penetration assembly.

As discussed in Subsection 6.2.2.2, there is adequate mixing of containment atmosphere so that local stratification or pocketing of hydrogen does not occur. The analyzer cubicles are located at elevation 43.0 ft of the Reactor Auxiliary Building (RAB). The analyzer system control panel is located in the control room.

A grab sample cylinder located at elevation 43.0 ft of the RAB is provided to permit hydrogen concentration measurement independent of the containment hydrogen analyzer detector.

6.2.5.2.2 Containment Hydrogen Recombiner Subsystem

The containment hydrogen recombiners control hydrogen in containment by using heat to cause recombination of liberated hydrogen with free oxygen in the air to form water.

The hydrogen recombiner system is described in Westinghouse Topical Report WCAP 7709-L[18] and shown on Figure 6.2-63. Supplement 1 through 4 of WCAP 7709-L were accepted by NRC on May 1, 1976. It is designed seismic Category I and Quality Group B requirements.

Each recombiner consists of a thermally insulated vertical metal duct with electric resistance metal sheathed heaters provided to heat a continuous flow of containment air to a temperature which is sufficient to cause a reaction between the hydrogen and the oxygen in the air. The recombiner is provided with an outer enclosure to provide protection from water spray coming from the Containment Spray System. The recombiner consists of an inlet preheater section, a heater-recombination section, a mixing chamber, and a cooling/exhaust section. Mixing of containment air is by the containment fan coolers and their associated ductwork as discussed in Subsection 6.2.2.2.2 by the turbulence introduced by the containment sprays, and by the process of natural diffusion of combustible gas with the containment air. Air is drawn into the recombiner by natural convection and passes first through the preheater section. This section consists of a shroud placed around the central heater section to take advantage of heat conduction through the walls to preheat the incoming air. This accomplishes the dual functions of reducing heat losses from the recombiner and of preheating the air.

The warmed air passes through an orifice plate and then enters the electric heater section where it is heated to approximately 1150°F to 1400°F causing recombination to occur. The flow then enters the cooling/exhausting section where the stream is mixed and diluted with cooler containment air in order to discharge the stream back into the containment atmosphere at a lower temperature.

Each hydrogen recombiner system has a removal capacity which is sufficient to limit concentrations of gases within the containment to safe concentrations; i.e., concentrations below the flammability limits. After a three hour startup period, the recombiner efficiency is 99-100 percent and the effluent does not exceed 100°F above ambient.

The unit is manufactured primarily of corrosion-resistant, high-temperature material for major structural components, except for the base which is steel. The electric hydrogen recombiner used conventional type electric resistance heaters sheathed with Incoloy-800 which is an excellent corrosion resistant material for this service. These heaters are designed to operate with sheath temperatures equal to those used in certain commercial heaters; however, these recombiner heaters operate at significantly lower power densities than in commercial practice.

The recombiners are located on the elevation 62.0 feet of the containment. They are inaccessible following a LOCA, and as such there is no sharing of recombiners among St. Lucie Units 1 and 2 or with other facilities. The hydrogen recombiners are designed for 60 years normal and one year post LOCA conditions. Design and performance data for the recombiners are listed in Table 6.2-55.

Each of the two recombiners is 100 percent capacity, and is connected to a separate onsite power source so that no single failure results in a total loss of recombiner function.

The recombiner is started by the operator by manual action from the control room. The operator is alerted when the containment H2 level reaches three volume percent as signaled by the redundant Class 1E alarms of the Containment Hydrogen Analyzer System. Plant procedures provide guidance to the operator on when to start the hydrogen recombiner following a LOCA.

6.2.5.2.3 Containment Hydrogen Purge System

The Continuous Containment Purge/Hydrogen Purge System is provided as a further possible means of controlling hydrogen inside the containment following a LOCA. This system is provided as required by the NRC, although no single failure following a LOCA would necessitate its use. Therefore, the system is non-safety-related except for the containment penetrations and isolation valves which are seismic Category I and Quality Group B. See Table 6.2-57 for a failure mode and effects analysis.

The only redundancy required in the system is to assure the containment isolation function, as discussed in Subsection 6.2.4. Functional and operational redundancy of the system is not provided, as the system serves only as a diverse means of backup to the already redundant containment hydrogen recombiners. However, the system is capable of controlling hydrogen inside containment following a LOCA independent of the operation of recombiners. Table 6.2-56 shows the design data and materials for hydrogen purge system.

The system consists of a purge makeup penetration line, an exhaust penetration line, two exhaust fans and interconnecting ductwork between the fan discharge and suction header of the Shield Building Ventilation System (see Figure 9.4-11).

The system is actuated by manual operator action from the control room by opening the isolation valves on the exhaust and makeup lines and starting the exhaust fan. The operator makes the decision to use the purge system based on readings from the containment hydrogen analyzers.

The system draws air from the dome and from elevation 51.0 ft. of the containment by the system exhaust fan through the continuous containment purge air cleaning unit where it is filtered prior to release to the environment. Air can also be drawn by the exhaust fan and discharged to the Shield Building Ventilation System where it is filtered prior to release to the environment as discussed in Subsection 6.2.3. A separate makeup air line to the containment is located in the Reactor Auxiliary Building.

The system is located in the Reactor Auxiliary Building at elevation 43.0 ft. with the exception of the piping and isolation valves which are inside the containment.

The portions of system piping penetrating containment and associated containment isolation valves are designed to the codes and standards specified in Subsection 6.2.4.3. The ductwork and filters of the Shield Building Ventilation System, which treat the purge exhaust, are designed to the codes and standards specified in Subsection 6.5.1. The continuous containment purge clean-up unit and the hydrogen purge exhaust ductwork connecting the SBVS is not designed as safety related because the hydrogen purge system is not the main system for combustible gas control. However, the air clean-up unit and ductwork is seismically supported. The only portion of the system which would be exposed to the post-LOCA environment in containment is the inboard containment isolation valves and associated piping. These valves are active containment isolation valves, and as such will be qualified as specified in Subsection 6.2.4.2.

6.2.5.3 Design Evaluation

6.2.5.3.1 Functional Evaluation

The Containment Combustible Gas Control System (CGCS) provides the capability to monitor and maintain hydrogen concentrations within safe limits following a LOCA. The CGCS design conforms to the Regulatory Guide 1.7, "Control of Combustible Gas Concentrations in Containment Following a Loss-of-Coolant Accident," September 1976 (R1).

Instrumentation provided for the system and discussed in Subsection 6.2.5.5 provides ample monitoring and indicating capabilities for complete control of the hydrogen control and sampling operations. Complete separation of redundant containment isolation valve control switches and wiring is provided. Internal wiring associated with redundant systems are separated by the metal enclosures which are permanently marked with identifying letters. In no way is exposed wiring from one redundant system be in close proximity with the exposed wiring of the other redundant system.

Sufficient concrete shielding is provided for the hydrogen analyzers to allow access for inspection and repair. Table 12.3A-7 provides access requirements for the H2 Analyzer during accident conditions.

The hydrogen recombiner and hydrogen analyzers are designed as seismic Category I and are located in the containment and Reactor Auxiliary Building, respectively. A failure mode and effects analysis for the combustible gas control system is shown in Table 6.2-57.

6.2.5.3.2 Analysis of Hydrogen Generation

Following a LOCA, hydrogen gas is generated inside the containment by the following sources:

- Release of hydrogen dissolved in the reactor coolant
- Metal-water reaction involving the zirconium fuel cladding and the reactor coolant.
- Radiolytic decomposition of water.
- Corrosion of metals and paints by solutions used for emergency core cooling and containment spray.
- Radiolytic decomposition of solid organic materials.

a) Dissolved Hydrogen

During normal plant operation, some hydrogen is dissolved in the Reactor Coolant System water. The concentration can range from 10 to 50 cc (STP)/kg (H_2O) (see Subsection 9.3.4). Assuming that the Reactor Coolant system contains as much as 500,000 lbm of water at the maximum hydrogen concentration, 423 scf of hydrogen are dissolved in the coolant.

$$500{,}000 \text{ lbm} \times 0.4536 \frac{\text{kg}}{\text{lbm}} \times 50 \frac{\text{cc}}{\text{kg}} \text{ (STP)} \times 3.631 \times 10^{-5} \frac{\text{ft}^3}{\text{cc}} \times$$

$$1.057 \frac{\text{scf}}{\text{ft}^3 \text{ (STP)}} = 423 \text{ scf}$$

This is assumed to be released instantaneously to the containment, but is only a minor source of hydrogen. Similarly, the concentration of dissolved oxygen in the primary coolant is less than 0.1 ppm. This represents 0.04 lbm of dissolved oxygen, a very small amount.

b) Metal-Water Reaction

As a result of a LOCA, elevated fuel cladding temperatures cause the zirconium to react with steam according to the following reaction:

$$Zr + 2\,H_2O \rightarrow ZrO_2 + 2H_2$$

Regulatory Guide 1.7 (R1) stipulates the amount of hydrogen that should be assumed to result from this metal-water reaction, for determining the performance requirements for the hydrogen recombiners. That amount is five times the maximum amount calculated in accordance with 10 CFR 50.46, but no less than the amount that would result from reaction of all the metal in the outside surfaces of the cladding cylinders surrounding the fuel (excluding the cladding surrounding the plenum volume) to a depth of 0.00023 inches. The maximum amount of zirconium calculated to react during ECCS operation is one percent. With the required factor of five, the amount assumed to react for purposes of hydrogen generation analysis is five percent. This five percent reaction is the governing requirement, rather than the

0.00023 inches reaction depth. The St. Lucie Unit 2 active core contains approximately 48,000 lbm of zircaloy, and for the hydrogen generation analysis it is assumed that five percent of this reacts instantaneously.

c) Radiolytic Hydrogen Generation

Water is decomposed into free hydrogen and oxygen by the absorption of energy emitted by fission products contained in the fuel and fission products intimately mixed with the water. The process is described by the conservative value $G(H_2)$ = 0.5 molecule per100 ev as specified in Regulatory Guide 1.7 (R1). The assumed distribution of fission products is the distribution specified in Regulatory Guide 1.7 (R1).

According to this distribution, one percent of the solids and 50 percent of the halogens present in the core are intimately mixed with the reactor coolant water. The noble gases are assumed to be released to the atmosphere. For fission products intimately mixed with the water, the fraction of the radiation absorbed by the water is 100 percent for both betas and gammas. For fission products remaining in the core, the fraction absorbed is 10 percent for gammas and zero for betas. These assumptions are summarized in Table 6.2-58. The beta and gamma releases were combined according to this model in calculating the amount of hydrogen generated by radiolysis.

The normalized decay power curve is provided on Figures 6.2-31 and 6.2-32. The thermal power assumed for this analysis is 2700 Mwt.

d) Corrosion of Metals

The use of aluminum, zinc and zinc-base paint has been restricted inside the St. Lucie Unit 2 containment.

For calculations of hydrogen generated due to corrosion, the long term containment temperature history used is given on Figure 6.2-64. It is an extension of the DBA LOCA transient for the containment atmosphere shown on Figure 6.2-39. It is assumed that late in the accident the curve levels off and the temperature remains constant.

The sources of aluminum are listed in Table 6.2-59. The hydrogen generation due to corrosion of aluminum was determined from the containment temperature transient and the aluminum corrosion rate data. The aluminum corrosion rate was taken from Reference 19. It is for a spray solution which contains sodium hydroxide and hence is much more corrosive than the hydrazine spray solution used in St. Lucie Unit 2. Thus the corrosion rate used here is extremely conservative and complies with Regulatory Guide 1.7 (R1). The aluminum corrosion rate as a function of time is shown on Figure 6.2-65.

The exposed zinc is found in wire rope restraint socket speltering (for the reactor coolant pumps) and in galvanized steel. Galvanized steel is present mainly in ductwork, cable trays, conduits, tube supports/hangers, instrument racks and platforms. The sources of zinc are itemized in Table 6.2-59. The hydrogen generation due to corrosion of metallic zinc was obtained by superimposing the

containment temperature transient for the design basis LOCA on the zinc corrosion rate data. The zinc corrosion rate was determined from the results of tests reported in Reference 20 for the concentration of boric acid which is used in the spray solution. The zinc corrosion rate as a function of time is shown on Figure 6.2-66.

Other surfaces, including platform framing, restraint structures, equipment supports, miscellaneous steel, and the polar crane, are coated rather than galvanized. A list of coated surfaces is given in Table 6.1-2. All uninsulated surfaces coated with a zinc-base primer are top coated with a non-zinc finish coat. The hydrogen generation rate due to zinc in the primer is negligible. Although the zinc-base primer is not directly exposed to the spray solution because it is covered with a non-zinc-base finish coat, an assumption made for the hydrogen generation analysis includes a hydrogen contribution as a result of the corrosion of all zinc-base paint primers exposed to a LOCA environment. The paint corrosion rate used is taken from Figure 9 of D. Van Rooyen's report [21] which is derived from the paper by Zittel.[22] This corrosion correlation is combined with the containment temperature transient to obtain the paint hydrogen generation rate (see Figure 6.2-67). It is assumed that zinc- based paint is a continuously present source for hydrogen in containment throughout the DBA (i.e., an indefinite thickness of paint was assumed).

e) Radiolysis of Solid Organic Materials

Hydrogen evolution due to radiolysis of solid organic materials is a negligible source inside the containment as compared to radiolytic hydrogen generation by water. Solid organic materials inside containment consist primarily of cable material and a small amount of unqualified organic materials described in Subsection 6.1.2.

A review has been conducted to determine the total quantity of cable material (jacket and insulation) inside the containment. The amount of cable material inside containment is 10,779 pounds of power cable; 15,138 pounds of control cable; and 27,945 pounds of low-level cable for a total of 53,862 pounds. Adding a 10 percent contingency factor the total quantity of cable material is 59,249 pounds. PC/M 05128 replaced existing ICI MI (Mineral Insulated) cable with organic cable increasing the weight of cable material for low-level cable from 27,945 pounds to 28,813 pounds. This in turn increases the total weight of cable material inside containment from 53,862 pounds to 54,731 pounds. As a result the 10 percent contingency factor is reduced to 8 percent.

To illustrate the order of magnitude of hydrogen evolution due to radiolysis of cable insulation, a conservative analysis was performed. There are approximately 59,000 pounds of cable insulation and jacket material in the containment. The major ingredient is a type of vulcanized chlorinated rubber compound. Gas yields from organic material reported in the literature are very conservative since tests are performed on thin sections in a vacuum; while diffusion through thick cable and jacket to the surface causes gas trapping and hydrogen recombination. Reference 25 indicates that elastomers and rubbers have G values ranging from .15 to .8 (G value = molecules of gas evolved / 100 ev). Using a conservative high G value of .8, and a total 30-day dose of 1.4×10^8 rads (Appendix D, NUREG-0588), results in a total hydrogen evolution of 2260 ft^3 . This amount is approximately, 0.9 percent of the containment volume, and insignificant compared to metal-water reaction, water radiolysis and metal corrosion sources. The effect is further reduced when the time

scale for gas evolution is considered, and the fact that more realistic estimates would probably reduce the volume almost an order of magnitude.

The total amount of protective coatings and organic materials used inside the containment that do not meet the requirements of ANSI N101.2 (1972) and Regulatory Guide 1.54 is approximately six cubic feet. The total quantity of combustible gases that can be formed from these unqualified organic materials under DBA conditions is 4.2 pounds maximum of 1625 cubic feet at STP conditions. These figures are based on the following:

Using the conservative assumption that all of the hydrogen in the unqualified materials will be released as hydrogen gas under DBA conditions and the conservative postulation of 1 percent hydrogen by weight in these materials for an average density of 70 pounds per cubic foot, the calculation indicated that a maximum weight of 4.2 lbs. of hydrogen would be evolved into containment. This translates to 1624.6 cubic feet at STP conditions. For the total containment volume of 2.5×10^6 cubic feet, the hydrogen percent by volume would be about 0.06 percent. This value is insignificant compared to the steady state maximum value of 3.2 percent by volume accumulated hydrogen during the operation of the hydrogen recombiner as shown on Figure 6.2-68.

Figure 6.2-68 shows the hydrogen production as a function of time for each individual source and for the total.

Regulatory Guide 1.7 (R1) sets a limit of four volume percent for the hydrogen concentration. Branch Technical Position CSB 6-2, "Control of Combustible Gas Concentrations in Containment Following a Loss of Coolant Accident", (11/24/75) also recommends a margin, such as 0.5 volume percent, between the hydrogen concentration limit and hydrogen concentration at which the equipment would be activated. Based on these considerations, operation of a hydrogen recombiner is assumed to begin at a hydrogen concentration of 3.0 volume percent. Figure 6.2-68 shows that this occurs approximately 3.5 days after the accident.

Although two recombiners are provided inside the containment, one is sufficient to maintain the hydrogen concentration below the required level. The Continuous Containment Purge/Hydrogen Purge System is a backup system which will most likely never be operated. The flow rate for each recombiner is 100 scfm. The flow rate for the Continuous Containment Purge/Hydrogen Purge System can be throttled to 100 cfm. Figure 6.2-68 shows the hydrogen concentration as a function of time with the recombiner(s) or the purge system in operation. The concentration history is shown for operation of one recombiner or the Continuous Containment Purge/Hydrogen Purge System in any of its modes serves to keep the hydrogen concentration below the four volume percent limit of Regulatory Guide 1.7 (R1).

6.2.5.3.3 Hydrogen Mixing Inside Containment

The containment fan cooler system provided for cooling and adequate mixing of containment air is discussed in Subsection 6.2.2.2.2. Fan coolers are provided which adequately mix the containment air. Adequate ducting is provided to all the containment compartments and subcompartments which assures no accumulation of combustible gas in pockets. Mixing of containment air is also accomplished by the process of natural diffusion of combustible gas with the containment air.

The long term operating requirements for the Containment Cooling System is to provide for containment atmosphere blending to prevent stratification and possible pocketing of hydrogen gas and not so much the heat removal. Air is continuously introduced upwards into the dome from outlets on the ring header. Air and hydrogen are thus mixed and displaced to lower levels of the containment.

6.2.5.3.4 EPU Impact on Containment Combustible Gas Control

The EPU has no impact on the fundamental mixing mechanisms discussed in section 6.2.5.3.3 or on the capability of the hydrogen monitoring system to diagnose beyond design-basis hydrogen concentrations.

6.2.5.4 Tests and Inspections

Preoperational tests and manufacturer's parameters form the basis for establishing the Combustible Gas Control System (CGCS) reference characteristic. This information is used to determine the required frequency of testing as well as verifying test results.

Visual inspection and functional testing are performed at specified intervals as part of the Technical Specifications. Visual inspection is made of the containment Penetrations and all piping associated with the CGCS as required by the ASME Code, Section XI.

Seismic and environmental qualification of the H2 recombiner is shown in Sections 3.10 and 3.11.

6.2.5.5 Instrumentation Requirements

System instrumentation and control, as indicated in Table 6.2-60, is provided in the control room for post-LOCA monitoring. Indicating lights show the operating status of the hydrogen analyzers and hydrogen recombiners in the control room. Also provided in the control room are position indication for the hydrogen analyzer sampling line isolation valves, hydrogen concentration recording device, qualified panel meter, indication of the temperature of the heating elements and the amount of power drawn by the hydrogen recombiner. The system is to be manually controlled after an accident based on information obtained from the hydrogen analyzer. The analyzer controls located in the control room enable the operator to open and close the sample valves within the containment in sequence and record the hydrogen concentration. Sample valve positions are indicated in the control room panel. The analyzers have a setpoint for an alarm, at three volume percent hydrogen.

The operation of the hydrogen recombiner is continuously monitored in the control room. Thermocouples are provided to continuously monitor the recombiner, and proper recombiner operation after an accident is assured by measuring the amount of electric power to the recombiner from the power supply which is located in the Reactor Auxiliary Building. The proper amount of air flow through the recombiner is fixed during initial tests and checkout by an orifice plate on the recombiner inlet.

The containment hydrogen purge has individual control switches for all fans and isolation valves in the control room. Valve position indications are also provided in the control room.

6.2.6 CONTAINMENT LEAKAGE TESTING

The containment including its associated penetrations, piping and isolation valves, has been designed to limit leakage to 0.5 percent of the weight of the contained air per day at the peak accident pressure during a DBA. Per Reference 26, the DBA peak accident pressure (Pa) for the containment test pressure is to be considered the analyzed LOCA containment peak pressure. As required by GDC 52, 53 and 54, preoperational and periodic leakage testing of the primary containment and penetrations will be performed. The requirements for leakage rate testing are given in Appendix J to 10 CFR 50. Note that Technical Specification Amendment 88, dated February 10, 1997, was approved which allows Appendix J, Option B testing. This testing allows the licensee to establish intervals for containment leak-testing based on the performance history and risk significance of the components (containment, penetrations, and valves). All Type A, B, and C testing requirements will be performed at intervals determined by the containment leakage rate testing program (See Technical Specification 6.8.4). The criteria for the new testing intervals is evaluated based on individual performance history and the permitted intervals specified in NRC letter dated August 27, 2015. See Reference 41 (page 6.2-81).

The program for leak rate testing is performed in two parts. The integrated leak rate test (ILRT) pressurizes the primary containment and tests the containment vessel, penetrations and isolation valves simultaneously; the local leakage rate test is performed on a more frequent basis and tests applicable penetrations and isolation valves on an individual basis. This program of leakage rate testing verifies the leaktight integrity of the containment vessel, penetrations and isolation valves during the life of the plant.

6.2.6.1 Containment Integrated Leak Rate Test

After installation of penetrations, appropriate piping and isolation valves, but prior to core loading, a preoperational containment integrated leak rate test (Type A test) is performed as well as an overload pressure test (see Subsection 3.8.2). Periodic Type A tests are performed during the life of the unit to verify the continued leaktight integrity of the containment systems.

Type A tests are conducted in accordance with the provisions of Appendix J, Option B to 10 CFR 50.

Prior to the preoperational or periodic Type A leak rate tests, a general inspection of the accessible interior and exterior surfaces of the containment vessel is performed to ensure that there is no evidence of structural deterioration which may affect either the containment structural integrity or leaktightness. If there is evidence of structural deterioration, the Type A leak rate test is not performed until corrective action is taken in accordance with repair procedures, nondestructive examinations and tests as specified in the applicable codes. Results of the inspections, any deterioration found and any corrective actions taken are documented and reported per the containment leakage rate testing program, and available for inspection at plant site.

During the period of the performance of the Type A test no repairs or adjustments are made so that the containment is tested in as close to the "as is" condition as practical. During the period between completion of one Type A test and initiation of the containment inspection for the subsequent Type A test, repairs or adjustments are made to components whose leakage exceeds that specified in the Technical Specifications, as soon as practical after identification. If during a Type A test potential excessive leakage paths are identified which will interfere with

satisfactory completion of the test, or which result in the Type A test not meeting the acceptance criteria, the Type A test is terminated and the leakage through such paths measured using local leakage testing methods. Repairs and/or adjustments to equipment are made and the Type A test re-performed. The corrective actions taken and the change in leakage rate determined are included in the test report available for inspection at the plant site.

Containment systems are lined up to simulate post-accident conditions for the Type A test with exceptions as permitted under 10 CFR 50 Appendix J, Option B. The reactor and Reactor Coolant System are maintained in a cold shutdown condition. The closure of the containment isolation valves for the Type A test is accomplished by normal operation and without any preliminary exercising or adjustments (e.g., no tightening of valve after closure by valve motor). Repairs to malfunctioning or leaking valves are made as necessary. Information on valve closure malfunction or valve leakage that requires correction before the test is included in the test report available for inspection at the plant site.

Those portions of systems which potentially are open to the containment atmosphere following a LOCA (i.e., GDC 56 systems) and systems connected to the reactor coolant pressure boundary (GDC 55 systems) are opened or vented to the atmosphere for the Type A test. Vented systems are drained of water or other fluids to the extent necessary to assure exposure of the system containment isolation valves to containment air test pressure and to assure that they are subjected to the peak differential pressure or a penalty is added to the Type A test results based on LLRT results for the system. Systems required to maintain the unit in a cold shutdown condition are operable in their normal mode and are not vented or drained. However, any of these systems that are containment leakage paths and require Type C or bypass local leakage tests as defined in Subsection 6.2.4 have the results of the local leakage tests added to the result of the Type A tests. Systems used during the Type A test for pressurizing the containment or sensing the leakage are not lined up in the post-accident positions but any leakage from the isolation valves in these systems is determined by local methods and the results are added to the Type A test. Systems that operate in post-accident conditions and filled with water are not vented or drained for the Type A test. Systems which form closed seismic Category I systems inside containment (as defined by GDC 57) are not vented to the containment atmosphere.

The air used to pressurize the containment is conditioned for temperature and humidity to the extent necessary to prevent moisture condensation in the containment at the test pressure. The air used to pressurize the containment is essentially oil free to prevent coating of the containment walls with oil or interfering with the test instrumentation.

The method selected for the determination of leakage is consistent with the requirements of Appendix J, and/or Appendix J, Option B of 10 CFR 50 with the option of using NRC approved methods for performing the leak rate testing and calculating the results.

Instrumentation is provided to monitor the containment during leakage rate testing. This instrumentation is designed, calibrated and tested to provide high accuracy to ensure that the containment atmosphere parameters are precisely measured.

The test instrumentation is specified in the test procedure. This includes instrumentation to measure containment pressure, temperature and humidity.

An error analysis of these instruments is made to establish the sensitivity of the instrumentation and to verify that the instrumentation system selected is acceptable for the measurement of leakage rates in the range desired.

Sensing devices are located at different locations in the containment to measure average temperature and humidity. Location of the temperature and humidity sensors is made with consideration of the temperature and humidity patterns in the containment. These patterns are employed in determination of the mean representative temperature and humidity for the absolute method of leakage rate testing. The use of fans to minimize temperature variations in regions of the containment is allowed but the fans are of limited horsepower to minimize potential heat input.

The precision pressure measuring device is located outside of the containment and is connected to the containment via a test penetration.

The preoperational Type A test is conducted at the peak accident pressure (P_a) and a reduced pressure selected for periodic testing (P_t). P_t is not less than one-half of P_a. Periodic type tests are conducted at P_a or P_t .

The containment environmental conditions are stabilized for a period of about four hours prior to the start of a leakage rate test. Leakage rate tests are not started until temperature equilibrium is attained.

The leakage rate test period extends to 24 hours of sustained internal pressure. If it is demonstrated to the satisfaction of the NRC that the leakage rate is accurately determined during a shorter test period, the agreed upon shorter period is used. 10 CFR 50 Appendix J, Option B approved by T.S. Amendment #88 allows use of methodology for a shorter duration test.

Pressure, temperature and humidity observations are made within the containment and recorded during the course of the leakage rate test at hourly intervals as a minimum. Pressure and temperature measurements of the outside atmosphere are made at the same time interval. The times of the observations are noted in hours and minutes. A dated log of events and pertinent observations is maintained during the leakage rate test. The correctness of data is attested to by those responsible for the test and, where specified by the test procedure, by a qualified witness.

At the conclusion of the leakage rate test, the accuracy of the Type A test is verified by a supplemental test method. The supplemental test injects into or bleeds from the containment an accurately measured amount of air. The supplemental test method selected is conducted for a sufficient duration to establish accurately the change in leakage rate between the Type A test and the supplemental test. The quantity of air injected into or bled from the containment during the supplemental test is between 0.75 and 1.25 of the allowable leakage rate (La). Leakage rate acceptance criteria are as follows:

The peak pressure (P_a) measured leakage rate (L_{am}) is less than 0.75 of the allowable leakage rate (L_a). The containment vessel and its penetrations are designed to limit leakage (L_a) to no more than 0.5 weight percent of the internal free volume of the containment in 24 hours at the peak accident pressure (P_a).

The reduced pressure (P_t) measured leakage rate (L_{tm}) is less than 0.75 of the allowable reduced pressure leakage rate (L_t). Lt is established during the preoperational Type A test and is determined by:

- if; $L_{tm}/L_{am} \leq 0.7$

$$L_t = L_a (L_{tm}/L_{am})$$

- if; $L_{tm}/L_{am} > 0.7$

$$L_t = L_a (P_t/P_a)^{1/2}$$

The results of the supplement verification test are acceptable provided the difference between the leakage determined during the Type A test and the supplemental test is within 25 percent of the allowable leakage rate (L_a or L_t).

If a Type A test fails the acceptance criteria or the results of the supplemental test do not agree within 25 percent of the allowable leakage rate, the reason is determined, corrective action is taken and a successful Type A or supplemental test, as applicable, is performed.

6.2.6.2 Containment Penetration Leakage Rate Test

Penetration local leakage rate tests, referred to as Type B tests, are performed on the containment penetrations, closure hatches, and airlocks that incorporate flexible bellows, resilient seats, flexible metal seats or gaskets as a part of the primary containment boundary. All closure seats of the type mentioned are provided with test taps for local leakage rate testing without pressurization of the entire containment volume. All bellows are individually testable.

Subsection 3.8.2.1.1 describes the mechanical penetrations and electrical penetrations of the containment.

Of the piping penetrations, only the main steam and feedwater penetrations have flexible expansion bellows. All other process piping penetrations have the process pipe welded directly to the steel containment vessel and are leak tested during the Type A test. The fuel transfer tube has a durable gasketed flanged closure to permit Type B leakage rate testing. In addition, flexible expansion bellows connect the fuel transfer tube to the containment vessel walls and require Type B testing.

The electrical penetrations are seated cannisters which require Type B leakage testing.

The construction hatch is a seal welded assembly which is leak tested during the Type A test. No Type B testing is required. The maintenance hatch closure is double gasketed to permit Type B leak testing.

Two types of leak testing are performed on the personnel airlock and the emergency escape airlock. The airlock doors are provided with double gasketed seals to permit leak testing. In addition, the entire airlock is pressurized and leak tested on a periodic basis to leak test the seals and closures other than the doors. Strongbacks are placed on the inner door during this test to prevent unseating.

All Type B local leakage rate testing is performed at the peak accident pressure P_a.

Local leakage rate testing is performed by pressurizing the test space to the required pressure with air and either:

a) measuring the makeup flow required to maintain a constant pressure or,

b) measuring the rate of pressure drop with the pressure source isolated.

The method used depends upon the magnitude of the leakage found.

The acceptance criteria for this leakage rate testing is combined with the isolation valve leakage rate testing (Type C leak testing) discussed in Subsection 6.2.6.3. The acceptance criteria is that the combined leakage rate of penetrations and isolation valves subject to Type B and Type C testing is less than 0.60 L_a.

Sources of leakage in excess of the acceptance criteria are repaired and the corrective actions taken are reported in the test report available for inspection at the plant site.

6.2.6.3 Containment Isolation Valve Leakage Rate Test

Containment isolation valve leakage rate tests, referred to as Type C tests, are performed on the containment isolation valves that are required to close and limit containment leakage during LOCA. Table 6.2-62 identifies the containment isolation valves that require Type C leak testing. Subsection 6.2.4.4 defines the bypass leakage paths and identifies the containment isolation valves subject to bypass leakage testing, and also provides justification for not doing so.

All Type C and bypass leak rate tests are performed at the peak accident pressure, P_a . The test method is identical to that described in Subsection 6.2.6.2 for Type B leak testing. The provisions for leak testing are shown in Table 6.2-62. The Type C tests and bypass leakage tests are similar with the exception of the acceptance criteria.

The combined leakage rate of penetrations and isolation valves subject to Type B and Type C testing is less than 0.60 L_a.

The combined leakage rate of all isolation valves subject to bypass leakage testing is less than .12L_a.

Corrective actions taken are reported to the NRC as a part of the test report available for inspection at the plant site.

6.2.6.4 Scheduling and Reporting of Periodic Tests

After the preoperational leakage rate tests, a set of three Type A tests is performed at approximately equal intervals during each 10 year service period. The final test of each set is conducted when the plant is shutdown for the 10 year plant in-service inspections (Note that these service intervals have changed based on Appendix J, Option B testing).

Type B tests, except tests for airlocks, are performed during each reactor shutdown for refueling or other convenient intervals, but in no case at intervals greater than two years. Airlocks are tested at six month intervals. Airlock door gasket leak rate tests are performed after each opening of the door except when the airlock is being used for multiple entries when such a test

is performed once per three days (Note that these service intervals have changed based on Appendix J, Option B testing).

Type C tests are performed during each reactor shutdown for refueling but in no case at intervals greater than two years (Note that these service intervals have changed based on Appendix J, Option B testing).

The preoperational and subsequent periodic tests are the subject of a summary technical report available for inspection at the plant site.

These reports are prepared in accordance with the requirements of 10 CFR 50, Appendix J and/or Appendix J, Option B. The report shall contain an analysis and interpretation of the leakage rate test data for the Type A test results to the extent necessary to demonstrate the acceptability of the containment leakage rate in meeting the acceptance criteria.

Leakage test results from Type A, B, and C tests that failed to meet the acceptance criteria are reported in a separate accompanying summary report that includes an analysis and interpretation of the test data. Results and analysis of the supplemental verification test employed to demonstrate the validity of the leakage rate measurement are also included.

6.2.6.5 Special Test Requirements

Any major modification or replacement of a component which is part of the primary reactor containment boundary, or resealing of a seal welded door, is performed after the preoperational leakage rate test is followed by either a Type A, Type B, Type C or bypass leakage test (as applicable) for the area affected by the modification. The measured leakage from this test is included in a test report submitted to the NRC.

However modifications, replacements or resealing of seal welded doors, performed directly prior to the conduct of scheduled leakage tests do not require a separate test.

Bypass leakage testing and the secondary containment functional design are given in Subsections 6.2.4 and 6.2.3, respectively.

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TABLE 6.2-1

POSTULATED ACCIDENTS FOR CONTAINMENT DESIGN

Containment Design Parameter	Postulated Accidents	Mass and Energy Release Reference
A. Containment Peak Pressure Temp-erature	Limiting Updated Loss-of-coolant accident (LOCA)	
	Double-ended hot leg slot (DEHLS), 19.24 ft^2 area (minimum safety injection)	
	Extended Power Uprate Main steam line breaks (MSLB)	
	5.41 ft^2 MSLB, 100.3% power Containment Cooling Train Failure	
	5.41 ft^2 MSLB, 75% power, Containment Cooling Train Failure	-
	5.41 ft^2 MSLB, 50% power, Containment Cooling Train Failure	-

TABLE 6.2-1 (Con't)

	Containment Design Parameter	Postulated Accidents	Mass and Energy Release Reference
A.	Containment Peak Pressure Temp-erature (Cont'd)	5.41 ft^2 MSLB, 25% power, Containment Cooling Train Failure	-
		5.41 ft^2 MSLB, 0% power, Containment Cooling Train Failure	-
		5.41 ft^2 MSLB, 100.3% power, MFIV Failure	-
		5.41 ft^2 MSLB, 75% power, MFIV Failure	-
		5.41 ft^2 MSLB, 50% power, MFIV Failure	-
		5.41 ft^2 MSLB, 25% power MFIV Failure	-
		5.41 ft^2 MSLB, 0% power, MFIV Failure	-
		5.41 ft^2 MSLB, 100.3% power, MSIV Failure	
		5.41 ft^2 MSLB, 75% power, MSIV Failure	-
		5.41 ft^2 MSLB, 50% power, MSIV Failure	-
		5.41 ft^2 MSLB, 25% power, MSIV Failure	-
		5.41 ft^2 MSLB, 0% power, MSIV Failure	-
		5.41 ft^2 MSLB, 100.3% power, EQ (peak temperature) MSIV Failure	Table 6.2-12G
B.	Subcompartment Peak Pressure	<u>Reactor Cavity</u>	
		100 in^2 hot leg guillo-tine (HLG)	Table 6.2-14A and B

TABLE 6.2-1 (cont'd)

Containment Design Parameter	Postulated Accidents	Mass and Energy Release Reference
B. Subcompartment Peak Pressure (1) (Cont'd)	200 in^2 discharge leg guillotine (DLG)	Table 6.2-15A and B
	Steam generator compartment	
	1000 in^2 hot leg guillotine (HLG) (2)	Table 6.2-16A and B
	1400 in^2 suction leg guillotine (SLG) (SG Nozzle) (2)	Table 6.2-17A and B
	1400 in^2 suction leg guillotine (SLG) (RCP Nozzle) (2)	Table 6.2-18A and B
	532 in^2 suction leg slot (SLS) (RCP elbow) (2)	Table 6.2-19
	532 in^2 suction leg slot (SLS) (S.G. elbow) (2)	Table 6.2-19
	1400 in^2 discharge leg guillotine (DLG) (RCP Nozzle) (2)	Table 6.2-20A and B
	1559 in^2 main steam line guillotine (5)	Table 6.2-24
	Pressurizer Subcompartment	
	161 in^2 double ended pressurizer surge line guillotine break (Pressurizer nozzle) (4)	Table 6.2-21A and B
	9.28 in^2 double ended pressurizer-relief line guillotine break (Pressurizer nozzle) (3)	Table 6.2-22
	11.87 in^2 double ended spray line guillotine-break (Pressurizer nozzle) (4)	Table 6.2-23A and B
C. Containment differential pressure	Inadvertent operation of the Containment Heat Removal System (Both trains)	N/A
D. Containment ECCS Minimum pressure-	Refer to Subsection 6.2.1.5	N/A

(1) Analysis is no longer required due to application of the LBB criteria (refer to UFSAR 6.2.1.2.3)

(2) This break is eliminated due to application of the LBB criteria (refer to UFSAR 6.2.1.2.3)

(3) The pre-EPU M&E release data remains unchanged at EPU conditions (refer to UFSAR 6.2.1.2.3)

(4) The pre-EPU M&E release data slightly increase at EPU conditions (refer to UFSAR 6.2.1.2.3)

(5) The pre-EPU M&E release data for this break is not the limiting case

TABLE 6.2-2

CALCULATED VALUES FOR CONTAINMENT PARAMETERS

Parameter		Design Basis Accident	Calculated Value
Peak Containment Atmosphere Pressure			
a.	LOCA (original)	9.82 ft^2 DESLS (max. SI)	41.8 psig
a1.	LOCA (EPU)	19.24 ft^2 DEHLS (min. SI)	43.43 psig
b.	MSLB	5.41 ft^2 MSLB, 0% Failure of one Containment Cooling Train	37.49 psig
Peak Containment Atmosphere Temperature			
a.	LOCA (original)	9.82 ft^2 DESLS (max. SI)	271.4°F
a1.	LOCA (EPU)	19.24 ft^2 DEHLS (min. SI)	266.66°F
b.	MSLB	5.41 ft^2 EQ-MSLB, 100.3% Failure of a MSIV to close	377.33°F
Peak CCW Temperature			
a.	LOCA (EPU)	9.82 ft^2 DESLS (min. SI)	119.93°F
Peak Subcompartment Pressure			
a.	Reactor Cavity (1)	200 in^2 discharge leg guillotine	86.0 psid
b.	Steam Generator	1400 in^2 suction leg guillotine at nozzle (2)	5.9 psid
c.	Pressurizer	161 in^2 surge line guillotine at nozzle (3)	1.3 psid (El. 62') 22.7 psid (El. 29.5')
Differential Pressure			
a.	Containment	Inadvertent operation of the Containment Heat Removal System	0.6 psid
b.	Shield Building	Inadvertent operation of the Containment Heat Removal System	0.615 psid
Minimum Pressure		DEDLG	See Subsection 6.2.1.5

(1)Analysis is no longer required due to application of the LBB criteria (refer to UFSAR 6.2.1.2.3)

(2)This break is eliminated due to application of the LBB criteria (refer to UFSAR 6.2.1.2.3)

(3)The pre-EPU M&E release data slightly increase at EPU conditions (refer to UFSAR 6.2.1.2.3)

TABLE 6.2-3

PRINCIPAL CONTAINMENT DESIGN PARAMETERS

Parameter	Design	Margin[1]	
Containment			
Internal design pressure, psig			
(LOCA original)	44.0	5.26%	
(LOCA analysis to support EPU	44.0	1.29%	
(MSLB)	44.0	14.80%	
Differential design pressure, psid	1.05	5%	EC280084
ILRT	43.48		
Net free volume, 10^6 ft^3	2.50	Not applicable	
Design leak rate, percent free volume per day at 44.0 psig	0.5	Not applicable	
Shield Building			
External design pressure, psig	3.0	22%	EC280084
Subcompartments			
Reactor cavity design wall loading Spacially varied peak valve, psid	172	100%	
Steam generator compartment design wall loading, psid	24.0	307%	
Pressurizer compartment design upper wall loading, psid	14.0	977%	
Pressurizer compartment design lower wall loading, psid	24.0	6%	

NOTES:

(1)Margin (%) $\frac{\text{design value - peak calculated value}}{\text{peak calculated value}} \times 100$

Actual margin, i.e., the margin between design values and peak calculated values when using realistic or median parameter values would be much larger.

TABLE 6.2-4

SUMMARY OF CALCULATED CONTAINMENT PRESSURE AND TEMPERATURE

A. LOCA

	DESLS (max. SI, original)	DEHLS (min. SI, analysis to support EPU)
Break Size, ft^2	9.82	19.24
Peak Pressure, psig	41.8	43.43
Peak Temperature, F	271.4	266.66
Time of Peak Pressure, sec	210	19.8
Time to End of Blowdown, sec	20.4	11.70
Energy Release to Containment at End of Blowdown BTU x 10^{6*}	287.13	316.99

* Includes energy addition due to metal-water reaction.

TABLE 6.2-4 (Cont'd)

C. MSLB-COOLING TRAIN FAILURE

% Power	100.3	75	50	25	0
MSLB Break Size, ft^2	5.41	5.41	5.41	5.41	5.41
Peak Pressure, psig	35.06	35.59	33.51	34.11	37.49
Peak Temperature, F	380.97	377.28	374.32	371.47	367.56
Time of Peak Pressure, sec	63.74	63.60	123.91	126.21	204.50
Time of End of Blowdown, sec	104.0	119.0	139.0	179.0	229.0
Energy release to Containment at End of Blow-down BTU x 10^6	253.6	259.3	269.9	289.6	335.9

D. MSLB-MAIN FEEDWATER ISOLATION VALVE FAILURE

% Power	100.3	75	50	25	0
MSLB Break Size, ft^2	5.41	5.41	5.41	5.41	5.41
Peak Pressure, psig	33.89	32.60	32.23	32.75	35.05
Peak Temperature, F	379.78	376.05	373.08	370.21	366.32
Time of Peak Pressure, sec	57.74	103.00	119.74	123.03	196.16
Time of End of Blowdown, sec	104.0	119.0	144.0	184.0	229.0
Energy release to Containment at- End of Blowdown BTU x 10^6	254.9	260.6	271.4	291.4	337.2

TABLE 6.2-4 (Cont'd)

E. MSLB-MAIN STEAM ISOLATION VALVE FAILURE

% Power	100.3	75	50	25	0
MSLB Break Size, ft^2	5.41	5.41	5.41	5.41	5.41
Peak Pressure, psig	35.05	33.53	32.98	33.50	35.63
Peak Temperature, F-	382.99	379.25	376.25	373.37	339.31
Time of Peak Pressure, sec	57.74	57.60	117.28	122.71	193.79
Time to End of Blowdown, sec	104.4	119.0	139.0	179.0	229.0
Energy release to Containment of- End of Blowdown BTU x 10^6	261.3	266.6	276.9	296.5	342.2

TABLE 6.2-5

INITIAL CONDITIONS FOR LOCA CONTAINMENT PEAK PRESSURE-TEMPERATURE ANALYSIS

Parameter	Value
Reactor Coolant System	
Reactor power level, MWt(1)	3030
Vessel inlet cold leg temperature, F	554
Pressurizer pressure, psia	2,250
Containment	
Pressure, psia	15.41
Temperature, F	120
Relative humidity, %	45
Component cooling water base temperature, F	105
Refueling water storage pool temperature, F	104
Net free volume, x 10^6 ft^3	2.499735
Stored Water	
Usable refueling water storage pool (minimum), gal	290,300 credited for safety analysis; 386,735 for ECCS/CS strainer submergence
Safety injection tanks, ft^3	5,952

NOTES:

(1) At design overpower to 100.3 percent and normal liquid levels.

TABLE 6.2-6

ENGINEERED SAFETY FEATURE SYSTEMS OPERATING ASSUMPTIONS FOR LOCA CONTAINMENT PEAK PRESSURE ANALYSIS

System/Item*	Design Capacity	Value Used for LOCA Peak Pressure
Passive Safety Injection System		
Number of accumulators (safety injection tanks)	4	4
Pressure, psig	500	650
Volume, ft^3/tank (total available)	1850	1488
Active Safety Injection Systems		
High-pressure safety injection		
Number of headers/pump	2	2
No. of lines/header	4	4
Number of pumps	2	2
Low-pressure safety injection		
No. of headers/pump	1	1
Number of lines/header	2	2
Number of pumps	2	2
Containment Spray System		
Number of lines	2	1
Number of pumps	2	1
Number of headers	2	1
Flow rate, gpm/pump	3450 (runout)	2700
Containment Fan Coolers		
Number of Units	4	2

* See analysis (Ref. 41) for additional inputs

TABLE 6.2-6 (Cont'd)

System/Item	Design Capacity	Value Used for LOCA Peak Pressure Analyses
Heat Removal Rate, 10^6 BTU/hr	277.2 @ 280 F 128.16 @ 200 F 15.66 @ 120 F	267.2* @ 280 F 120.8* @ 200 F 11.76* @ 120 F *Accounts for 1% voltage under frequency
Cooling Water flowrates, gpm/unit	1200	1518
Source of Cooling Water	Component Cooling Water	Component Cooling Water
Base Cooling Water Temperature, F	100	105
<u>Heat Exchangers</u>		
Shutdown heat exchangers (shell and U-Tube)		
Number	2	1
Heat transfer area, ft^2	5790/Hx	5790 / Hx
Overall heat transfer coefficient, Btu/hr-ft^2-F	274.0	274.0
Flow rates:		
Tube side, gpm	3450	2850
Shell side, gpm	4820/Hx	3719/Hx
Temperature:		
Time Dependent	---	---
Source of cooling water	Component cooling water	Component cooling water

TABLE 6.2-7

CONTAINMENT PASSIVE HEAT SINKS

Description	Material	Thickness	Surface Area(Ft^2)	Exposure Side 1	Exposure Side 2	Thermal Conductivity (BTU/hr-ft-F)	Volumetric Heat Capacity (BTU/ft^3-F)
1. Containment Concrete Structures (walls and floor slabs (4)	Paint	4-7 mils	All concrete surfaces are painted			.25-.375	47.1
	Surfaces	4-7 mils				.16	28.0
	Concrete					1.0	31.9
	Surfaces						
	Secondary Shield Wall	4'	1451	Cont liquid	*		
		4'	20438	Cont vapor	*		
	Primary Shield Wall	7'3"	814	Cont liquid	*		
		7'3"	1943	Cont vapor	*		
		5'11"	76	Cont liquid	*		
		5'11"	9894	Cont vapor	*		
		3'	21	Cont liquid	*		
		3'	1195	Cont vapor	*		
	Massive Wall (interior surface only)	20'	725	Cont liquid	Ground		
	Shield Wall	2'	540	Cont liquid	*		
		2'	3180	Cont vapor	*		
	Ground Floor at El 23.0' and El 18.0' heavy Foundation (interior surface only)	20'	5485 6035	Cont liquid Cont vapor	Ground		
	Operating Floor at El 62.0	4'	13450	Cont vapor	*		
	Steam Generator Shield Wall	4'	6390	Cont vapor	*		
	Pressurizer Shield Wall	2'	3050	Cont vapor	*		
	Missile Shield Cover	3'	851	Cont vapor	*		
	Hatch Cover	4'	670	Cont vapor	*		
	Ring Wall	2'	2760	Cont vapor	*		
	Reactor Cavity Floor	22'	380	Cont liquid	Ground		
	Sump Pit	3'	907	Cont liquid	(6)		
	Misc Walls	2'	1250	Cont vapor	*		

TABLE 6.2-7(Cont'd)

Description	Material	Thickness	Surface Area(Ft^2)	Exposure Side 1	Exposure Side 2	Thermal Conductivity (BTU/hr-ft-°F)	Volumetric Heat Capacity (BTU/ft^3-°F)
1. (Cont'd)	Concrete Steam Generator Base	1.81 1.81	370	Cont vapor Cont liquid	(7) (7)	1.6	31.9
	Vertical Wall		520				
	Connecting Web	2'	1632	Cont vapor	*	1.0	31.9
	Electrical Tunnel	3'	5400	Cont liquid	(6)		
	Air Tunnel	3'	710	Cont liquid	(6)		
	Access Way	3 '	1717	Cont liquid	(6)		
	Vertical Surface Area for trenches Outside Secondary Shield Wall	3'	6410	Cont liquid	(6)	1.0	31.9
2. Uninsulated Pipe Stainless Steel (SS) Carbon Steel (CS)	SS 12” sch 40	0.406 in	519	Cont vapor		9.8	54.0
	SS 12” sch 40	0.406 in	183	Cont liquid		9.8	54.0
	SS 10” sch 40S	0.365 in	521	Cont vapor		9.8	54.0
	SS 8” sch 40S	0.322 in	3903	Cont vapor		9.8	54.0
	SS 6” sch 40S	0.280 in	1545	Cont vapor		9.8	54.0
	SS 1” sch 160S	0.250 in	5	Cont vapor		9.8	54.0
	SS 4” sch 40S	0.237 in	1245	Cont vapor		9.8	54.0
	SS 4” sch 40S	0.237 in	445(1)	Cont vapor		9.8	54.0
	SS 3/4” sch 160S	0.219 in	13	Cont vapor		9.8	54.0
	SS 2” sch 80S	0.218 in	374	Cont vapor		9.8	54.0
	SS 2” sch 80S	0.218 in	221	Cont liquid		9.8	54.0
	SS 3” sch 40S	0.216 in	512	Cont vapor		9.8	54.0
	SS 3” sch 40S	0.216 in	262	Cont liquid		9.8	54.0
	SS 1” sch 80S	0.179 in	643	Cont liquid		9.8	54
	SS 1” sch 80S	0.179 in	43	Cont vapor		9.8	54.0
	CS 2” sch 40	0.154 in	635	Cont liquid		25.9	53.57
	CS 2” sch 40	0.154 in	749(1)	Cont vapor		25.9	53.57
	SS 2” sch 40S	0.154 in	2	Cont vapor		9.8	54.0
	SS 1/2” sch 80S	0.147 in	3	Cont vapor		9.8	54.0
	CS 1” sch 40	0.133 in	163	Cont vapor		25.9	53.57
	SS 2-1/2”, 3”, 3-1/2”, 4” sch 10S	0.120 in	763	Cont vapor		9.8	54.0
	SS 3/4” sch 40S	0.113 in	8	Cont vapor		9.8	54.0
	CS 1/2” sch 40	0.109 in	136	Cont vapor		25.9	53.57
3. Safety Injection Tanks(4)	Stainless Steel	1.785 in	4905	Cont vapor	(7)	9.8	54
4. Reactor Dr. Tk.	SS	5/16 in	230	Cont liquid	(7)	9.8	54

TABLE 6.2-7(Cont'd)

Description	Material	Thickness(in)	Surface Area(Ft^2)	Exposure Side 1	Exposure Side 2	Thermal Conductivity (BTU/hr-ft-F)	Volumetric Heat Capacity (BTU/ft^3-F)
5. Quench Tank (painted)	SS	5/16	300	Cont vapor	(7)	9.8	54
6. H_2 Recombiner	SS	2-1/2	200	Cont vapor	(7)		
7. Refueling Machine	Steel	2-1/2	945	Cont vapor	Cont vapor	25.9	53.57
8. Crane Steel	Steel	3/16	500	Cont vapor	Cont vapor	25.9	53.57
		7/32	5000	Cont vapor	Cont vapor	25.9	53.57
		1/4	120	Cont vapor	Cont vapor	25.9	53.57
		3/8	4800	Cont vapor	Cont vapor	25.9	53.57
		1/2	1100	Cont vapor	Cont vapor	25.9	53.57
		1-3/8	1900	Cont vapor	Cont vapor	25.9	53.57
9. Instr. housing (Painted)	Cast Aluminum	0.25	9	Cont vapor	(7)	120	34.3
10. Instr. Racks	Galvanized	3.5 mils	310	Cont vapor	(7)	611.0	40.6
	Steel	.154				25.9	53.57
	Galvanized	3.5 mils	550	Cont vapor	Cont vapor	611.0	40.6
	Steel	.39				25.9	53.57
	Galvanized	3.5 mils				64.0	40.6
	Galvanized	3.5 mils	175	Cont vapor	Cont vapor	611.0	40.6
	Steel	.25				25.9	53.57
	Galvanized	3.5 mils				611.0	40.6
11. Tubing	316 SS	0.065	3000	Cont vapor	Process fluid	9.8	54.0
12. Fittings	316 SS	0.065	300	Cont vapor	Process fluid	9.8	54.0
13. Instr Manifolds	316 SS	1.25	25	Cont vapor	Process fluid	9.8	54.0
14. Piping seismic restraints and hangers	CS	.75	20000	Cont vapor	Cont vapor	25.9	53.57
	CS	.75	5000	Cont liquid	Cont liquid	25.9	53.57
15. Electrical Conduit	Galvanized	.8 mil	31089	Cont vapor	(7)	64.0	40.6
	Steel	.154			(7)	25.9	53.57
	Galvanized	.8 mil	10328	Cont vapor	(7)	64.0	40.6
	Steel	.133			(7)	25.9	53.57
16. Electrical boxes	Galvanized	2 mil	2185	Cont vapor	(7)	64.0	40.6
	Steel	.083			(7)	25.9	53.57

TABLE 6.2-7(Cont'd)

Description	Material	Thickness (in)		Surface Area(Ft^2)	Exposure Side 1	Exposure Side 2	Thermal Conductivity (BTU/hr-ft-F)	Volumetric Heat Capacity (BTU/ft^3-F)
17.Cable Trays (without covers)	Galvanize	2.5 mil		13000	Cont vapor	Cont vapor	64.0	40.6
	Steel	.065					25.9	53.57
	Galvanize	2.5 mil					64.0	40.6
Cable Trays (with covers)	Galvanize	2.5 mil		14666	Cont vapor	(7)	64.0	40.
	Steel	.065		8666			25.9	53.57
	Steel	.049		6000			25.9	53.57
18.Tube Supports	Galvanize	3.5 mil		1875	Cont vapor	Cont vapor	64.0	40.6
	Steel	.109					25.9	53.57
	Galvanize	3.5 mil					64.0	40.6
19.Cable Tray Restraints	Steel	.25		7836	Cont vapor	Cont vapor	25.9	53.57
	Steel	.3125		718	Cont vapor	Cont vapor	25.9	53.57
	Steel	.375		315	Cont vapor	Cont vapor	25.9	53.57
	Steel	.1875		1479	Cont vapor	Cont vapor	25.9	53.57
	Steel	.235		314	Cont vapor	Cont vapor	25.9	53.57
	Steel	.269		628	Cont vapor	Cont vapor	25.9	53.57
	Steel	.5		141	Cont vapor	Cont vapor	25.9	53.57
	Steel	1.0		316	Cont vapor	Cont vapor	25.9	53.57
20.Cont Vessel Cylinder (3)	Steel	1.92		55900	Cont vapor	Annulus	25.9	53.57
21.Cont Vessel Dome (3)	Steel	0.96		30800	Cont vapor	Annulus	25.9	53.57
22.Refueling Pool Exposed Steel	Stainless	0.1875	3' Conc Wall	1000	Cont vapor	Concrete	25.9	53.57
	Steel		6' Conc Wall	3300				
			7' Conc Wall	1800				
			20'Conc	2200				
23.Gratings, Ladders, Misc.	Galvanize	3.5 mils		18383	Cont vapor	Cont vapor	64.0	40.6
	Steel	.1875		13674			25.9	53.57
	Steel	.3125		3610			25.9	53.57
	Steel	.375		681			25.9	53.57
	Steel	.5		418			25.9	53.57
	Galvanize	3.5 mils					64.0	40.6
	Galvanize	3.5 mils		660	Cont vapor	(7)	64.0	40.6
	Steel	.1875		207			25.9	53.57
	Steel	2.0		453			25.9	53.57
24.Handrails and Treads	Galvanize	3.5 mils		5260	Cont vapor	(7)	64.0	40.6
	Steel	.14					25.9	53.57
	Aluminum	.4375		674	Cont vapor	Cont vapor	120.	34.3

TABLE 6.2-7(Cont'd)

Description	Material	Thickness (in)	Surface Area(Ft^2)	Exposure Side 1	Exposure Side 2	Thermal Conductivity (BTU/hr-ft-F)	Volumetric Heat Capacity (BTU/ft^3-F)
25. Trench Covers	Steel	0.25	465	Cont vapor	Cont vapor	25.9	53.57
26. Elevator	Steel	0.25	2675	Cont vapor	Cont vapor	25.9	53.57
27. HVAC Duct	Galvanized	1.53 mil	23418	Cont vapor	Cont vapor	64.0	40.6
	Steel	.1046				25.9	53.57
	Galvanized	1.53 mil				64.0	40.6
28. HVAC Casings	Galvanized	1.53 mil	2045	Cont vapor	Cont vapor	64.0	40.6
	Steel	.1345				25.9	53.57
	Galvanized	1.53 mil				64.0	40.6
29. HVAC Fans	Steel	.375	5629	Cont vapor	Cont vapor	25.9	53.57
30. Embedded Steel(8)	Steel	.75	724	Cont vapor	Concrete	25.9	53.57
	Steel	1.0	2211	Cont vapor	Concrete	25.9	53.57
	Steel	1.5	15	Cont vapor	Concrete	25.9	53.57
	Steel	1.375	1583	Cont vapor	Concrete	25.9	53.57
	Steel	.75	180	Cont liquid	Concrete	25.9	53.57
	Steel	1.0	1458	Cont liquid	Concrete	25.9	53.57
		1.5	41	Cont liquid	Concrete	25.9	53.57
31. Pipe Restraints	Steel	.25	490	Cont vapor	Cont vapor	25.9	53.57
	Steel	.375	1248	Cont vapor	Cont vapor	25.9	53.57
	Steel	.42	1305	Cont vapor	Cont vapor	25.9	53.57
	Steel	.5	898	Cont vapor	Cont vapor	25.9	53.57
	Steel	.5625	208	Cont vapor	Cont vapor	25.9	53.57
	Steel	.625	1759	Cont vapor	Cont vapor	25.9	53.57
	Steel	.688	967	Cont vapor	Cont vapor	25.9	53.57
	Steel	.72	533	Cont vapor	Cont vapor	25.9	53.57
	Steel	.75	2161	Cont vapor	Cont vapor	25.9	53.57
	Steel	.8125	179	Cont vapor	Cont vapor	25.9	53.57
	Steel	1.0	3613	Cont vapor	Cont vapor	25.9	53.57
	Steel	1.25	1352	Cont vapor	Cont vapor	25.9	53.57
	Steel	1.375	1200	Cont vapor	Cont vapor	25.9	53.57
	Steel	1.5	4074	Cont vapor	Cont vapor	25.9	53.57
	Steel	1.75	96	Cont vapor	Cont vapor	25.9	53.57
	Steel	2.0	788	Cont vapor	Cont vapor	25.9	53.57
	Steel	2.25	530	Cont vapor	Cont vapor	25.9	53-57
	Steel	2.5	274	Cont vapor	Cont vapor	25.9	53.57
	Steel	2.75	280	Cont vapor	Cont vapor	25.9	53.57
	Steel	3.25	150	Cont vapor	Cont vapor	25.9	53.57
		3.5	60	Cont vapor	Cont vapor		

TABLE 6.2-7(Cont'd)

Description	Material	Thickness (in)	Surface Area(Ft^2)	Exposure Side 1	Exposure Side 2	Thermal Conductivity (BTU/hr-ft-F)	Volumetric Heat Capacity (BTU/ft^3-F)
31. (Cont'd)	Steel[8]	4.0	56	Cont vapor	Concrete	25.9	53.57
	Steel[8]	2.25	18	Cont vapor	Concrete	25.9	53.57
	Steel[8]	1.5	2117	Cont vapor	Concrete	25.9	53.57
	Steel[8]	2.5	130	Cont vapor	Concrete	25.9	53.57
	Steel[8]	2.0	420	Cont vapor	Concrete	25.9	53.57
	Steel[8]	1.0	268	Cont vapor	Concrete	25.9	53.57
	Steel[8]	1.25	20	Cont vapor	Concrete	25.9	53.57
	Steel[8]	1.75	51	Cont vapor	Concrete	25.9	53.57
	Steel[8]	3.0	15	Cont vapor	Concrete	25.9	53.57
	Steel[8]	1.625	17	Cont vapor	Concrete	25.9	53.57
	Steel[8]	2.25	20	Cont liquid	Concrete	25.9	53.57
	Steel[8]	1.0	155	Cont liquid	Concrete	25.9	53.57
	Steel[8]	2.25	31	Cont liquid	Cont liquid	25.9	53.57
	Steel[8]	2.0	278	Cont liquid	Cont liquid	25.9	53.57
	Steel[8]	1.0	50	Cont liquid	Cont liquid	25.9	53.57
	Steel[8]	1.25	20	Cont liquid	Cont liquid	25.9	53.57
	Steel[8]	.683	30	Cont liquid	Cont liquid	25.9	53.57
	Steel[8]	.5	32	Cont liquid	Cont liquid	25.9	53.57
	Steel[8]	.375	40	Cont liquid	Cont liquid	25.9	53.57
32. Equipment Supports	Steel	.38	212	Cont vapor	Cont vapor	25.9	53.57
	Steel	.5	222	Cont vapor	Cont vapor	25.9	53.57
	Steel	.69	72	Cont vapor	Cont vapor	25.9	53.57
	Steel	.75	445.8	Cont vapor	Cont vapor	25.9	53.57
	Steel	1.0	341	Cont vapor	Cont vapor	25.9	53.57
	Steel	1.12	35	Cont vapor	Cont vapor	25.9	53.57
	Steel	1.5	763.5	Cont vapor	Cont vapor	25.9	53.57
	Steel	1.75	39	Cont vapor	Cont vapor	25.9	53.57
	Steel	2.0	2202.6	Cont vapor	Cont vapor	25.9	53.57
	Steel	2.5	289	Cont vapor	Cont vapor	25.9	53.57
	Steel	4.0	504.8	Cont vapor	Cont vapor	25.9	53.57
	Steel	5.0	78	Cont vapor	Cont vapor	25.9	53.57
	Steel	3.0	853.4	Cont vapor	Cont vapor	25.9	53-57
	Steel	.25	21	Cont vapor	Cont vapor	25.9	53.57
	Steel	1.25	570.6	Cont vapor	Cont vapor	25.9	53.57
	Steel	2.0	482.6	Cont vapor	Insulated	25.9	53.57
	Steel	4.0	99.2	Cont vapor	Insulated	25.9	53.57
	Steel	1.0	500	Cont liquid	Cont liquid	25.9	53.57
	Steel	1.5	397.6	Cont liquid	Cont liquid	25.9	53.57
	Steel	2.5	112	Cont liquid	Cont liquid	25.9	53.57
	Steel	3.0	681	Cont liquid	Cont liquid	25.9	53.57
	Steel	4.0	1039	Cont liquid	Cont liquid	25.9	53.57
	Steel	5.0	357	Cont liquid	Cont liquid	25.9	53.57
	Steel	6.0	288	Cont liquid	Cont liquid	25.9	53.57
	Steel	3.5	185	Cont liquid	Cont liquid	25.9	53.57
	Steel	2.0	206.7	Cont liquid	Cont liquid	25.9	53.57

TABLE 6.2-7(Cont'd)

Description	Material	Thickness (in)	Surface Area(Ft^2)	Exposure Side 1	Exposure Side 2	Thermal Conductivity (BTU/hr-ft-F)	Volumetric Heat Capacity (BTU/ft^3-F)
32. (Cont'd)	Steel	.25	10	Cont liquid	Cont liquid	25.9	53.57
	Steel	1.25	31	Cont liquid	Cont liquid	25.9	53.57
	Steel	.5	377	Cont liquid	Cont liquid	25.9	53.57
	Steel	1.75	107	Cont liquid	Cont liquid	25.9	53.57
	Steel	2.75	336	Cont liquid	Cont liquid	25.9	53.57
	Steel	2.625	76	Cont liquid	Cont liquid	25.9	53.57
	Steel	4.25	382	Cont liquid	Cont liquid	25.9	53.57
	Steel	.75	5.3	Cont liquid	Cont liquid	25.9	53.57
	Steel(8)	1.25	159.5	Cont vapor	Concrete	25.9	53.57
	Steel(8)	1.0	266.8	Cont vapor	Concrete	25.9	53.57
	Steel(8)	1.5	90.2	Cont vapor	Concrete	25.9	53.57
	Steel(8)	3.0	46	Cont vapor	Concrete	25.9	53.57
	Steel(8)	.5	25.5	Cont vapor	Concrete	25.9	53-57
	Steel(8)	2.0	16.4	Cont vapor	Concrete	25.9	53.57
	Steel(8)	.75	2.7	Cont vapor	Concrete	25.9	53.57
	Steel(8)	2.5	21.7	Cont vapor	Concrete	25.9	53.57
	Steel(8)	.5	3868.0	Cont liquid	Concrete	25.9	53.57
	Steel(8)	1.0	2.3	Cont liquid	Concrete	25.9	53.57
	Steel(8)	2.0	94.6	Cont liquid	Concrete	25.9	53.57
	Steel(8)	3.0	116.1	Cont liquid	Concrete	25.9	53.57
			142.2	Cont liquid	Concrete	25.9	53.57
	Steel	4.0					
	Steel(8)	.75	1.4	Cont liquid	Concrete	25.9	53.57
	Steel(8)	12.0	144.0	Cont liquid	Concrete	25.9	53.57
33. HVAC Duct Restraints	Steel	.1875	81	Cont vapor	Cont vapor	25.9	53.57
		.25	6721	Cont vapor	Cont vapor	25.9	53.57
		.288	206	Cont vapor	Cont vapor	25.9	53.57
		.3125	536	Cont vapor	Cont vapor	25.9	53.57
		.345	293	Cont vapor	Cont vapor	25.9	53.57
		.5	414	Cont vapor	Cont vapor	25.9	53.57
		.433	264	Cont vapor	Cont vapor	25.9	53.57
		.375	335	Cont vapor	Cont vapor	25.9	53.57
37. Containment Sump Strainer	SS	.048	5607	Cont liquid	Cont liquid	9.8	54
	SS	.375	25	Cont liquid	Cont liquid	9.8	54
	SS	.5	214	Cont liquid	Cont liquid	9.8	54
	SS	.5	27	Cont liquid	Concrete	9.8	54

TABLE 6.2-7 (Cont'd)

Notes:

(1) Piping is painted

(2) For all carbon steel surfaces see Section 6.1.2 for paint system specifications.

(3) For the steel containment vessel see Section 6.1.2 for paint system specifications.

(4) The given surface area for a concrete wall has been reduced to represent both sides of the wall since the faces often have different areas. A "*" in the exposure side 2 column identifies where this has been done and should be taken to mean both sides are exposed to the environment of exposure side one. The given thickness is that of the full wall.

(5) When both sides are exposed to containment environment - the area is of one side only.

(6) Exposure on side 2 is not applicable since it ranges from surfaces previously given to ground.

(7) The interior surface is not readily subject to the exposure of side 1 since that environment has no free path to the inner surface. The surface area represents the outer surface only and the heat sink is considered to be the full thickness.

(8) Where the steel is buried in concrete or backed by concrete this is indicated in the exposure side 2 column. In these cases the surface area represents that area exposed to the environment of the exposure side 1 column.

TABLE 6.2-8

SUMMARY OF PASSIVE HEAT SINKS
USED FOR THE CONTAINMENT ANALYSIS

Description	Thickness	Surface Area(Ft^2)	Exposure Side 1	Exposure Side 2	Thermal Conductivity (BTU/hr-ft-F)	Volumetric Heat Capacity (BTU/ft^3-F)
1. Containment Primary Cylinder	Top Coat - *	55,900	Cont vapor	Annulus	*	*
	Bottom coat - *				*	*
	Steel shell - 1.92				25.9	53.57
	Paint film - *				*	*
2. Containment Primary Dome	Top coat - *	30,800	Cont vapor	Annulus	*	*
	Bottom coat - *				*	*
	Steel dome - .96				25.9	53.57
	Paint film - *				*	*
3. Ground Floor - Concrete	Paint film - *	5,733.3	Cont vapor	Ground	*	*
	Surfacer - *				*	*
	Concrete - 2. ft				1.0	31.9
4. Concrete (shield walls concrete pads)	Paint film - *	64,023.4	Cont vapor	Insulated	*	*
	Surfacer - *				*	*
	Concrete - 2. ft				1.0	31.9
5. Concrete exposed to Containment Sump Water	Paint film - *	23,898.2	Cont liquid	Insulated	*	*
	Surfacer - *				*	*
	Concrete - 3. ft				1.0	31.9
6. Stainless Steel -	Stainless Steel -	8,300	Cont vapor	Insulated	9.8	54.0
	Concrete - 4. ft				1.0	31.9
7. Stainless Steel (piping other components)	Stainless Steel -	15,618	Cont vapor	Insulated	9.8	54.0
8. Galvanized steel and cable trays)	a) Zinc - .8 mil	41,417	Cont vapor	Insulated	64.0	40.6
	Steel - .1488 in				25.9	53.57
	b) Zinc - 1.53 mil	25,463	Cont vapor	Cont vapor	64.0	40.6
	Steel - .107 in				25.9	53.57
	Zinc - 1.53 mil				64.0	40.6
	c) Zinc - 3 mil	91,047	Cont vapor	Insulated	64.0	40.6
	Steel - .09041 in				25.9	53.57

* Coating specifications are described in Section 6.1.2.

TABLE 6.2-8 (cont'd)
SUMMARY OF PASSIVE HEAT SINKS USED FOR THE CONTAINMENT ANALYSIS

Description		Thickness	Surface Area(Ft^2)	Exposure Side 1	Exposure Side 2	Thermal Conductivity (BTU/hr-ft-F)	Volumetric Heat Capacity (BTU/ft^3-F)
9. Structural and Miscellaneous Exposed Steel	a)	Top coat - *	22,769	Cont vapor	Cont vapor	*	*
		Bottom coat - *				*	*
		Steel - .25 in				25.9	53.57
		Bottom coat - *				*	*
		Top coat - *				*	*
	b)	Top coat - *	12,539	Cont vapor	Cont vapor	*	*
		Bottom coat - *				*	*
		Steel - .375 in				25.9	53.57
		Bottom coat - *				*	*
		Top coat - *				*	*
	c)	Top coat - *	6,311	Cont vapor	Cont vapor	*	*
		Bottom coat - *				*	*
		Steel - .5 in				25.9	53.57
		Bottom coat - *				*	*
		Top coat - *				*	*
	d)	Top coat - *	24,357.8	Cont vapor	Cont vapor	*	*
		Bottom coat - *				*	*
		Steel - .75 in				25.9	53.57
		Bottom coat - *				*	*
		Top coat - *				*	*
	e)	Top coat - *	19,328.7	Cont vapor	Cont vapor	*	*
		Bottom coat - *				*	*
		Steel - 1.52141 in				25.9	53.57
		Bottom coat - *				*	*
		Top coat - *				*	*
	f)	Top coat - *	1,926.2	Cont vapor	Cont vapor	*	*
		Bottom coat - *				*	*
		Steel - 3.34176 in				25.9	53.57
		Bottom coat - *				*	*
		Top coat - *				*	*
	g)	Top coat - *	12,276	Cont vapor	Insulated	*	*
		Bottom coat - *				*	*
		Steel - .11206 in				25.9	53.57
	h)	Top coat - *	6,970.6	Cont vapor	Insulated	*	*
		Bottom coat - *				*	*
		Steel - 1.39856 in				25.9	53.57

See Analysis Reference (27) for assumed coating value. Coating specifications are described in Section 6.1.2.

TABLE 6.2-9

ACCIDENT CHRONOLOGIES

Limiting Double Ended Hot Leg Slot Break Sequence of Events
(Minimum SI Flow, 1 Containment Spray, 2 Containment Fan Coolers

TIME (SECONDS)	EVENT	SETPOINT/VALUE
0.0	Break Occurs, Reactor Trip and Loss of Offsite Power are Assumed	19.24 ft^2 break
0.59	Containment High-High Pressure Setpoint Reached	7.05 psig
11.702	End of Blowdown Phase	
19.80	Containment Peak Pressure and Temperature Occurs	43.43 psig, 266.66°F
24.15	Containment Fan Coolers Begin Removing Heat from Containment	
29.45	Containment Spray Flow Begins	
75.45	Full Containment Spray Flow	
2412.03	Switchover to sump recirculation as RWT reaches low level. Containment spray water cooled by Shutdown Cooling heat exchanger.	@ RWT injected volume of 290,300 gallons credited for safety analysis
1.0e+06	Transient Modeling Terminated	

TABLE 6.2-9 (cont'd)

ACCIDENT CHRONOLOGIES

Page 2 of this table has been deleted.

TABLE 6.2-9 (cont'd)

ACCIDENT CHRONOLOGIES

EPU

D. Worst Pressure Case MSLB

Time (seconds)	EVENT
0.0	Break occurs
3.14	Main Steam Isolation Setpoint
3.14	Reactor Trip Setpoint
3.14	Main Feedwater Isolation Setpoint
3.55	Containment Spray Setpoint
9.44	Main Feedwater Isolation Valves Closed
11.04	Main Steam Isolation Valves Closed
13.55	Full Fan Cooler Operation
63.2	Containment Spray on Full
204.50	Containment Peak Pressure
229.0	End of Blowdown

E. Worst Temperature Case MSLB

Time (seconds)	EVENT
0.0	Break Occurs
4.7	Main Steam Isolation Setpoint
4.7	Reactor Trip Setpoint
4.7	Main Feedwater Isolation Setpoint
5.22	Containment Spray Setpoint
11.0	Main Feedwater Isolation Valves Closed
12.6	Main Steam Isolation Valves Closed
14.87	Full Fan Cooler Operation
51.87	Containment Peak Temperature
64.87	Containment Spray on Full
110.0	End of Blowdown

Table 6.2-10
This table has been deleted.

TABLE 6.2-11

ASSUMPTIONS USED IN ANALYSIS OF INADVERTENT CONTAINMENTS

SPRAY SYSTEM ACTUATION

EC280084

Item	Assumed Value
Containment	
Initial temperature, F	120
Initial pressure, psia	14.28
Relative humidity, %	40 and 100
Net free volume (minimum), $ft.^3$	2.493×10^6
Passive heat sinks	ignored for conservatism
Containment Spray System	
Number of trains in operation	2
Flowrate total (runout flow)	7250
Refueling water temperature, F	55
Spray efficiency, %	100
Containment Fan Coolers	
Number of units in operation	4
Component Cooling Water temperature, F	60
Fan Cooler Heat Removal/unit (10^6Btu)	11.40 @ 120 F air 6.053@ 100 F air 1.190@ 70 F air
Containment Vacuum Breakers	
No. of Vacuum Breaker	2
No. assumed failed	1
Setpoint differential pressure to open Vacuum Breakers inwg	-14
Delay time to start opening Vacuum Breakers, sec	1.15

EC280084

EC280084

EC280084

EC280084

TABLE 6.2-11(Cont'd)

Item	Assumed Value	
Vacuum Break System flow area, ft.^{2}	1.77	
Loss coefficient	1.64	
Opening Rate Degrees/sec	12.86	EC280084
Shield Building		
Initial temperature F	56 and 110	EC280084
Initial pressure, psia	14.7	
Relative humidity, %	0	EC280084
Net free volume (minimum), ft^3	547,000	
Passive heat sinks	ignored for conservatism	

Table 6.2-12A
This table has been deleted.

Table 6.2-12B
This table has been deleted.

Table 6.2-12C
This table has been deleted.

Table 6.2-12D
This table has been deleted.

Table 6.2-12E
This table has been deleted

TABLE 6.2-12F

0% POWER MSLB, WITH ONE CONTAINMENT COOLING TRAIN (EPU)

TIME (SEC)	BREAK MASS RATE LBM/SEC	BREAK ENERGY RATE BTU/SEC		TIME (SEC)	BREAK MASS RATE LBM/SEC	BREAK ENERGY RATE BTU/SEC
0.00	8029.28	9.60E+06		7.999	5121.61	6.17E+06
0.199	7772.40	9.30E+06		8.199	5090.55	6.13E+06
0.399	7599.16	9.10E+06		8.399	5060.12	6.09E+06
0.599	7459.57	8.93E+06		8.599	5030.31	6.06E+06
0.799	7338.00	8.79E+06		8.799	5001.09	6.02E+06
0.999	7227.34	8.66E+06		8.999	4972.45	5.99E+06
1.199	7123.94	8.54E+06		9.199	4944.36	5.95E+06
1.399	7025.80	8.42E+06		9.399	4916.79	5.92E+06
1.599	6931.82	8.31E+06		9.599	4895.66	5.89E+06
1.799	6841.32	8.21E+06		9.799	4876.68	5.87E+06
1.999	6753.85	8.10E+06		9.999	4858.35	5.85E+06
2.199	6669.14	8.00E+06		10.199	4840.63	5.83E+06
2.399	6586.99	7.91E+06		10.399	4823.03	5.81E+06
2.599	6507.25	7.81E+06		10.599	4805.81	5.79E+06
2.799	6430.98	7.72E+06		10.799	4789.09	5.77E+06
2.999	6357.53	7.64E+06		10.999	4772.81	5.75E+06
3.199	6286.07	7.55E+06		11.199	2315.28	2.79E+06
3.399	6216.60	7.47E+06		11.399	2310.09	2.78E+06
3.599	6149.08	7.39E+06		11.599	2304.80	2.77E+06
3.799	6083.48	7.31E+06		11.799	2299.40	2.77E+06
3.999	6020.23	7.24E+06		11.999	2293.89	2.76E+06
4.199	5959.79	7.16E+06		12.199	2288.27	2.75E+06
4.399	5901.15	7.09E+06		12.399	2282.55	2.75E+06
4.599	5844.29	7.03E+06		12.599	2276.72	7.24E+06
4.799	5789.18	6.96E+06		12.799	2270.80	2.73E+06
4.999	5735.80	6.90E+06		12.999	2264.77	2.73E+06
5.199	5684.12	6.84E+06		13.199	2258.66	2.72E+06
5.399	5634.72	6.78E+06		13.399	2252.45	2.71E+06
5.599	5586.90	6.72E+06		13.599	2246.14	2.70E+06
5.799	5540.51	6.67E+06		13.799	2239.75	2.70E+06
5.999	5495.59	6.61E+06		13.999	2233.27	2.69E+06
6.199	5452.15	6.56E+06		14.199	2226.70	2.68E+06
6.399	5410.16	6.51E+06		14.399	2220.05	2.67E+06
6.599	5369.59	6.46E+06		14.599	2213.31	2.67E+06
6.799	5330.42	6.41E+06		14.799	2206.48	2.66E+06
6.999	5292.58	6.37E+06		14.999	2199.57	2.65E+06
7.199	5256.03	6.33E+06		15.199	2192.58	2.64E+06
7.399	5220.72	6.28E+06		15.399	2185.51	2.63E+06
7.599	5186.59	6.24E+06		15.599	2178.36	2.62E+06
7.799	5153.57	6.20E+06		15.799	2171.13	2.61E+06
15.999	2163.84	2.61E+06		59.995	1350.80	1.63E+06
16.199	2156.47	2.60E+06		61.995	1333.29	1.60E+06
16.399	2149.04	2.59E+06		63.995	1316.20	1.58E+06
16.599	2141.56	2.58E+06		65.995	1299.49	1.56E+06

TABLE 6.2-12F (continued)

0% POWER MSLB, WITH ONE CONTAINMENT COOLING TRAIN (EPU)

TIME (SEC)	BREAK MASS RATE LBM/SEC	BREAK ENERGY RATE BTU/SEC		TIME (SEC)	BREAK MASS RATE LBM/SEC	BREAK ENERGY RATE BTU/SEC
16.799	2134.02	2.57E+06		67.995	1283.15	1.54E+06
16.999	2126.43	2.56E+06		69.995	1267.16	1.52E+06
17.199	2118.80	2.55E+06		71.995	1251.50	1.50E+06
17.399	2111.14	2.54E+06		73.995	1236.16	1.49E+06
17.599	2103.46	2.53E+06		75.995	1221.14	1.47E+06
17.799	2095.49	2.52E+06		77.995	1206.41	1.45E+06
17.999	2087.39	2.51E+06		79.995	1191.97	1.43E+06
18.199	2079.29	2.50E+06		81.995	1177.80	1.42E+06
18.399	2071.20	2.49E+06		83.995	1163.89	1.40E+06
18.599	2063.13	2.48E+06		85.995	1150.10	1.38E+06
18.799	2055.08	2.48E+06		87.995	1135.94	1.36E+06
18.999	2047.07	2.47E+06		89.995	1121.71	1.35E+06
19.199	2039.10	2.46E+06		91.995	1107.47	1.33E+06
19.399	2031.18	2.45E+06		93.995	1093.28	1.31E+06
19.599	2023.31	2.44E+06		95.995	1079.28	1.30E+06
19.799	2015.51	2.43E+06		97.995	1065.55	1.28E+06
19.999	2007.77	2.42E+06		99.995	1052.10	1.26E+06
21.995	1935.40	2.33E+06		104.995	1019.59	1.22E+06
23.995	1872.89	2.26E+06		109.995	988.681	1.19E+06
25.995	1819.09	2.19E+06		114.995	959.245	1.15E+06
27.995	1771.23	2.13E+06		119.995	931.102	1.12E+06
29.995	1727.58	2.08E+06		124.995	904.243	1.08E+06
31.995	1687.73	2.03E+06		129.995	877.773	1.05E+06
33.995	1651.73	1.99E+06		134.995	852.363	1.02E+06
35.995	1619.30	1.95E+06		139.995	828.001	991238
37.995	1589.79	1.91E+06		144.995	804.709	962997
39.995	1562.45	1.88E+06		149.995	782.502	936074
41.995	1536.74	1.85E+06		154.995	760.458	909352
43.995	1512.39	1.82E+06		159.995	733.124	876223
45.995	1489.27	1.79E+06		164.995	703.800	840688
47.995	1467.26	1.77E+06		169.995	674.115	804725
49.995	1446.20	1.74E+06		174.995	642.957	766990
51.995	1425.92	1.72E+06		179.995	610.019	727112
53.995	1406.29	1.69E+06		184.995	574.609	684261
55.995	1387.26	1.67E+06		189.995	538.914	641088
57.995	1368.77	1.65E+06		194.995	502.725	597346
199.995	459.135	544661		399.995	0.803132	999.887
204.995	407.664	482454		404.995	0.786561	979.344
209.995	347.018	409264		409.995	0.770528	959.464
214.995	196.073	230433		414.995	0.755003	940.211
219.995	128.902	151448		419.995	0.739968	921.562
224.995	94.3073	110783		424.995	0.725401	903.49
229.995	2.92246	3601.28		429.995	0.711282	885.972
234.995	2.28154	2813.74		434.995	0.697593	868.985

TABLE 6.2-12F (continued)

0% POWER MSLB, WITH ONE CONTAINMENT COOLING TRAIN (EPU)

TIME (SEC)	BREAK MASS RATE LBM/SEC	BREAK ENERGY RATE BTU/SEC		TIME (SEC)	BREAK MASS RATE LBM/SEC	BREAK ENERGY RATE BTU/SEC
239.995	2.18982	2703.4		444.995	0.671436	836.519
244.995	1.99445	2463.65		449.995	0.658934	820.998
249.995	1.97833	2445.48		454.995	0.646796	805.927
254.995	1.81987	2250.79		459.99	0.574523	715.922
259.995	1.80126	2228.99		464.99	0.565348	704.532
264.995	1.68609	2087.44		469.99	0.557058	694.243
269.995	1.65446	2049.19		474.99	0.548922	684.143
274.995	1.57072	1946.26		479.99	0.541051	674.372
279.995	1.53023	1896.8		484.99	0.533355	664.817
284.995	1.46718	1819.28		489.99	0.525874	655.528
289.995	1.42317	1765.28		494.99	0.518577	646.468
294.995	1.37243	1702.86		499.99	0.511466	637.638
299.995	1.32971	1650.31		504.99	0.504975	629.578
304.995	1.28703	1597.76		509.99	0.499434	622.703
309.995	1.24751	1549.07		514.99	0.493985	615.941
314.995	1.21251	1505.95		519.99	0.488614	609.275
319.995	1.17860	1464.15		524.99	0.483330	602.716
324.995	1.14690	1425.05		529.99	0.478132	596.264
329.995	1.11605	1386.98		534.99	0.473022	589.92
334.995	1.08702	1351.14		539.99	0.467999	583.684
339.995	1.05888	1316.38		544.99	0.463061	577.553
344.995	1.03218	1283.4		549.99	0.458207	571.526
349.995	1.00643	1251.56		554.99	0.453435	565.601
354.995	0.981836	1221.15		559.99	0.448744	559.776
359.995	0.958811	1192.67		564.99	0.444133	554.05
364.995	0.936754	1165.38		569.99	0.439599	548.419
369.995	0.915514	1139.09		574.99	0.435140	542.882
374.995	0.895063	1113.78		579.99	0.430756	537.437
379.995	0.875370	1089.39		584.99	0.426445	532.082
384.995	0.856362	1065.85		589.99	0.422205	526.815
389.995	0.838007	1043.11		594.99	0.418034	521.634
394.995	0.820270	1021.13		599.99	0.413932	516.538
439.995	0.684317	852.507		600	0.413924	516.528

TABLE 6.2-12G

EQ 100.3% POWER MSLB, WITH ONE FAILED MSIV (EPU)

TIME (SEC)	BREAK MASS RATE LBM/SEC	BREAK ENERGY RATE BTU/SEC		TIME (SEC)	BREAK MASS RATE LBM/SEC	BREAK ENERGY RATE BTU/SEC
0.00	7869.13	9.41E+06		8.799	5562.57	6.69E+06
0.199	7484.04	8.96E+06		8.999	5600.89	6.73E+06
0.399	7179.86	8.60E+06		9.199	5635.77	6.77E+06
0.599	6915.73	8.23E+06		9.399	5667.55	6.81E+06
0.799	6690.32	8.02E+06		9.599	5696.54	6.85E+06
0.999	6491.27	7.79E+06		9.799	5723.02	6.88E+06
1.199	6315.41	7.58E+06		9.999	5747.24	6.91E+06
1.399	6159.88	7.39E+06		10.199	5769.39	6.93E+06
1.599	6022.14	7.23E+06		10.399	5789.65	6.96E+06
1.799	5897.86	7.08E+06		10.599	5808.16	7.00E+06
2.199	5685.94	6.83E+06		10.999	5840.36	7.02E+06
2.399	5597.66	6.72E+06		11.199	5857.85	7.04E+06
2.599	5519.10	6.63E+06		11.399	5873.88	7.06E+06
2.799	5448.98	6.54E+06		11.599	5888.49	7.08E+06
2.999	5386.20	6.47E+06		11.799	5901.68	7.09E+06
3.199	5329.82	6.40E+06		11.999	5913.46	7.11E+06
3.399	5279.02	6.34E+06		12.199	5923.81	7.12E+06
3.599	5233.11	6.28E+06		12.399	5932.71	7.13E+06
3.799	5191.47	6.23E+06		12.599	5937.69	7.14E+06
3.999	5153.59	6.19E+06		12.799	5709.43	6.86E+06
4.199	5119.01	6.15E+06		12.999	5496.58	6.61E+06
4.399	5087.33	6.11E+06		13.199	5290.39	6.36E+06
4.599	5058.21	6.07E+06		13.399	5099.78	6.13E+06
4.799	5031.34	6.04E+06		13.599	4923.58	5.92E+06
4.999	5006.45	6.01E+06		13.799	4760.71	5.72E+06
5.199	4983.31	5.98E+06		13.999	4610.13	5.54E+06
5.399	4961.71	5.96E+06		14.199	4470.87	5.37E+06
5.599	4941.47	5.93E+06		14.399	4341.99	5.21E+06
5.799	4922.42	5.91E+06		14.599	4222.66	5.07E+06
5.999	4904.43	5.89E+06		14.799	4112.08	4.94E+06
6.199	4887.37	5.87E+06		14.999	4009.30	4.83E+06
6.399	4871.14	5.85E+06		15.199	3910.22	4.71E+06
6.599	4855.66	5.83E+06		15.399	3818.50	4.59E+06
6.799	4840.84	5.81E+06		15.599	3733.47	4.49E+06
6.999	4945.00	5.94E+06		15.799	3654.51	4.40E+06
7.199	5043.63	6.06E+06		15.999	3581.09	4.31E+06
7.399	5133.10	6.17E+06		16.199	3512.71	4.22E+06
7.599	5214.20	6.27E+06		16.399	3448.97	4.15E+06
7.799	5287.67	6.36E+06		16.599	3392.58	4.08E+06
7.999	5354.20	6.44E+06		16.799	3340.97	4.02E+06
8.199	5414.42	6.51E+06		16.999	3292.28	3.96E+06
8.399	5468.91	6.57E+06		17.199	3246.32	3.90E+06
8.599	5518.22	6.63E+06		17.399	3202.86	3.85E+06

TABLE 6.2-12G (continued)

EQ 100.3% POWER MSLB, WITH ONE FAILED MSIV (EPU)

TIME (SEC)	BREAK MASS RATE LBM/SEC	BREAK ENERGY RATE BTU/SEC		TIME (SEC)	BREAK MASS RATE LBM/SEC	BREAK ENERGY RATE BTU/SEC
17.599	3161.74	3.80E+06		83.995	954.202	1.19E+06
17.799	3122.80	3.75E+06		85.995	869.034	1.09E+06
17.999	3042.82	3.66E+06		87.995	779.495	981485
18.199	2968.85	3.57E+06		89.995	690.829	872158
18.399	2900.91	3.49E+06		91.995	605.228	766052
18.599	2837.40	3.41E+06		93.995	524.635	665623
18.799	2776.39	3.34E+06		95.995	452.847	575762
18.999	2714.08	3.26E+06		97.995	390.897	497934
19.199	2678.24	3.22E+06		99.995	335.540	428131
19.399	2665.36	3.20E+06		109.985	3.57043	4573.04
19.599	2652.66	3.19E+06		119.985	3.09985	3997.02
19.799	2640.16	3.17E+06		129.985	2.80184	3599.05
19.999	2627.87	3.16E+06		139.975	1.96532	2527.21
21.995	2518.30	3.03E+06		149.975	1.83404	2360.85
23.995	2431.30	2.93E+06		159.975	1.71201	2204.93
25.995	2359.30	3.84E+06		169.975	1.59999	2062.05
27.995	2293.28	2.80E+06		179.995	1.49787	1931.66
29.995	2230.09	2.72E+06		189.975	1.40686	1815.37
31.995	2172.25	2.66E+06		199.975	1.32225	1707.25
33.995	2120.12	2.59E+06		249.855	0.987842	1277.33
35.995	2071.64	2.53E+06		299.855	0.859872	1113.17
37.995	2026.47	2.48E+06		349.855	0.717463	930.736
39.995	1984.24	2.43E+06		399.855	0.614194	798.365
41.995	1944.14	2.38E+06		449.855	0.538752	701.65
43.995	1905.76	2.33E+06		499.855	0.478275	624.051
45.995	1868.92	2.29E+06		549.855	0.427640	558.999
47.995	1833.53	2.25E+06		599.855	0.384955	504.096
49.995	1799.37	2.20E+06		649.855	0.326078	427.53
51.995	1766.13	2.16E+06		699.855	0.290165	380.585
53.995	1733.87	2.13E+06		749.855	0.270007	354.193
55.995	1702.63	2.09E+06		799.855	0.252464	331.206
57.995	1672.48	2.05E+06		849.855	0.236177	309.858
59.995	1630.83	2.00E+06		899.855	0.219200	287.585
61.995	1574.52	1.94E+06		949.855	0.204117	267.793
63.995	1514.79	1.87E+06		999.855	0.189794	248.997
65.995	1477.23	1.82E+06		1049.85	0.177185	232.452
67.995	1438.26	1.77E+06		1099.85	0.164943	216.387
69.995	1397.24	1.72E+06		1149.85	0.153169	200.939
71.995	1353.21	1.67E+06		1199.85	0.143205	187.869
73.995	1302.67	1.61E+06		1249.85	0.131584	172.632
75.995	1244.21	1.54E+06		1299.85	0.120867	158.576
77.995	1179.03	1.47E+06		1349.85	0.110670	145.203

TABLE 6.2-12G (continued)

EQ 100.3% POWER MSLB, WITH ONE FAILED MSIV (EPU)

TIME (SEC)	BREAK MASS RATE LBM/SEC	BREAK ENERGY RATE BTU/SEC		TIME (SEC)	BREAK MASS RATE LBM/SEC	BREAK ENERGY RATE BTU/SEC
79.995	1108.81	1.38E+06		1399.85	0.100967	132.476
81.995	1033.93	1.29E+06		1449.85	9.08E-02	119.085
1499.85	8.22E-02	107.819		4399.71	1.15E-03	1.51044
1549.85	7.41E-02	97.1706		4499.71	6.77E-04	0.888537
1599.85	6.65E-02	87.2442		4599.71	1.2E-03	1.63853
1649.85	5.95E-02	78.0414		4699.71	1.06E-03	1.39328
1699.85	5.32E-02	69.769		4799.71	9.62E-04	1.26145
1749.85	4.78E-02	62.6604		4899.71	3.21E-04	0.421335
1799.85	4.23E-02	55.465		4999.71	-1.19E-01	1311.73
1849.85	3.74E-02	49.0424		5099.71	1.64E-03	2.15187
1899.85	3.30E-02	43.2941		5199.71	6.82E-04	0.894091
1949.85	2.72E-02	35.6669		5299.71	5.81E-04	0.762093
1999.85	2.48E-02	32.584		5399.71	-6.80E-01	1311.71
2049.85	2.18E-02	28.5982		5499.71	-9.18E-01	1311.71
2099.85	1.91E-02	25.0817		5599.71	1.32E-03	1.72716
2149.85	1.68E-02	21.989		5699.71	4.00E-04	0.524308
2199.85	1.58E-02	20.694		5799.71	2.98E-04	0.391065
2249.85	1.36E-02	17.8233		5899.71	-1.45E-03	-1.90563
2299.85	1.27E-02	16.6073		5999.71	-1.20E-03	-1.56807
2349.85	1.18e-02	15.5378		6099.71	1.68E-03	2.19994
2399.85	1.11E-02	14.5599		6199.71	1.93E-04	0.252607
2449.86	9.15E-03	12.0008		6299.71	9.22E-05	0.120938
2499.86	9.03E-03	11.8475		6399.71	-1.79E-03	-2.35158
2549.86	8.50E-03	11.1555		6499.71	-1.59E-03	-2.08458
2599.86	7.99E-03	10.4776		6599.71	1.79E-03	2.34213
2649.86	7.50E-03	9.84253		6699.71	6.71E-05	8.80E-02
2699.86	7.65E-03	10.0349		6799.71	-6.60E-02	1311.59
2749.86	7.12E-03	9.34323		6899.71	-1.72E-03	-2.2559
2799.86	6.68E-03	8.75927		6999.71	-1.92E-03	-2.52068
2849.86	6.30E-03	8.25934		7099.71	2.19E-03	2.86837
2899.86	5.95E-03	7.80592		7199.71	-2.15E-02	1311.37
2949.86	4.75E-03	6.23707		7299.71	-2.20E-01	1311.37
2999.86	4.65E-03	6.09755		7399.71	-1.80E-03	-2.36743
3099.71	4.20E-03	5.514		7499.71	-2.24E-03	-2.93238
3199.71	4.33E-03	5.67999		7599.71	2.35E-03	3.0761
3299.71	3.82E-03	5.01187		7699.71	-5.76E-02	1311.26
3399.71	3.47E-03	4.55734		7799.71	-3.42E-01	1311.26
3499.71	2.54E-03	3.32712		7899.71	-3.32E-03	-4.34957
3599.71	2.35E-03	3.07693		7999.71	-2.52E-03	-3.30405
3699.71	2.62E-03	3.44224		8099.71	5.69E-03	7.46329
3799.71	2.35E-03	3.09034		8199.71	9.01E-06	1.18E-02
3899.71	7.62E-04	1.00022		8299.71	-4.39E-01	1311.09

TABLE 6.2-12G (continued)

EQ 100.3% POWER MSLB, WITH ONE FAILED MSIV (EPU)

TIME (SEC)	BREAK MASS RATE LBM/SEC	BREAK ENERGY RATE BTU/SEC		TIME (SEC)	BREAK MASS RATE LBM/SEC	BREAK ENERGY RATE BTU/SEC
3999.71	1.41E-03	1.85447		8399.71	-4.66E-01	1311.09
4099.71	4.58E-03	6.00605		8499.71	-2.78E-03	-3.6472
4199.71	1.66E-03	2.17636		8599.71	-1.98E-01	1311.09
4299.71	1.51E-03	1.97773		8699.71	2.14E-04	0.280302
8799.71	-5.09E-01	1311.45		8999.71	-3.03E-03	-3.9747
8899.71	-5.56E-01	1311.45		9000.01	-3.03E-03	-3.97141

Integral 222533.0 Lbm 270.716E+06 BTU

TABLE 6.2-13

SUMMARY OF POSTULATED PIPE RUPTURES FOR CONTAINMENT SUBCOMPARTMENT ANALYSIS

Pipe	ID Inches	Location	Description	Break Area* (Sq. Inches)	Original Design Basis Release Rate Data Table Numbers**
Reactor Cavity (1)					
Hot Leg	42.0	Reactor Vessel Nozzle	Guillotine Break	100.	6.2-14A and 14B
Discharge Leg	30.0	Reactor Vessel Nozzle	Guillotine Break	200.	6.2-15A and 15B
Secondary Shield Wall Area					
Hot Leg (2)	42.0	Steam Generator Nozzle	Guillotine Break	1000.	6.2-16A and 16B
Suction Leg (2)	30.0	Steam Generator Nozzle	Guillotine Break	1400.	6.2-17A and 17B
Suction Leg (2)	30.0	Pump Nozzle	Circumferential Break	1400.	6.2-18A and 18B
Suction Leg (2)	30.0	Pump Elbow	Slot Break within ±90° from Elbow Crotch	532.	6.2-19
Suction Leg (2)	30.0	Steam Generator Elbow	Slot Break within ±90° from Elbow Crotch	532.	6.2-19
Discharge Leg (2)	30.0	Pump Nozzle	Guillotine Break	1400.	6.2-20A and 20B
Main Steam (5)	31.5	Point 16 (Figure 36E.1)	Full Double Ended Guillotine	1559	6.2-24
Pressurizer Area					
Pressurizer Surge Line (4)	10.1	Pressurizer Nozzle	Guillotine Break	161	6.2-21A and 21B
Pressurizer Relief Line (3)	3.44	Pressurizer Nozzle	Guillotine Break	9.28	6.2-22
Pressurizer Spray Line (4)	3.44	Pressurizer Nozzle	Guillotine Break	11.87	6.2-23A and 23B

* The Break Area given is total area available for flow from both sides of a given break location.

** Note that where two tables are given for circumferential break release rates, the total blowdown at a given time is equal to the sum of the rates given in the two tables

(1) Analysis is no longer required due to application of the LBB criteria (refer to UFSAR 6.2.1.2.3)
(2) This break is eliminated due to the application of LBB criteria (refer to UFSAR 6.2.1.2.3)
(3) The pre-EPU M&E release data remains unchanged at EPU conditions (refer to UFSAR 6.2.1.2.3)
(4) The pre-EPU M&E release data slightly increase at EPU conditions (refer to UFSAR 6.2.1.2.3)
(5) The pre-EPU M&E release data for this break is not the limiting case

TABLE 6.2-14A

(Historical)

MASS/ENERGY RELEASE RATES FOR 100 SQ IN
HOT LEG GUILLOTINE BREAK AT RV NOZZLE
FOR CONTAINMENT SUBCOMPARTMENT ANALYSIS
(FLOW FROM RV SIDE)

Cycle 1

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
0.00000	0.0	609.10	0.
.00100	330.5	609.10	204962.
.00200	668.6	609.00	407177.
.00300	998.6	609.00	608147.
.00400	1332.0	609.00	811188.
.00500	1669.0	609.00	1016421.
.00600	2001.0	609.00	1218609.
.00700	2323.0	608.90	1414475
.00800	2630.0	608.90	1605060.
.00900	2952.0	608.80	1797178.
.01000	3281.0	608.80	1997473.
.01200	3951.0	608.90	2405764.
.01400	4571.0	608.80	2782825.
.01600	5216.0	608.80	3175501.
.01800	5889.0	608.80	3582179.
.02000	6488.0	608.70	3949246.
.02200	6518.0	608.80	3968158.
.02400	6528.0	608.80	3974246.
.02600	6466.0	608.70	3935854.
.02800	6487.0	608.70	3948637.
.03000	6497.0	608.70	3954724.
.03200	6456.0	608.70	3929767.
.03400	6455.0	608.70	3929159.
.03600	6454.0	608.70	3928550.
.03800	6419.0	608.60	3906603.
.04000	6408.0	608.60	3698692.
.04200	6405.0	608.60	898083..
.04400	6385.0	608.60	3885911.
.04600	6375.0	608.60	3879825.
.04800	6374.0	608.60	3879216.
.05000	6361.0	608.50	3870669.
.05500	6335.0	608.50	3854848.
.06000	6290.0	608.40	3826836.
.06500	6237.0	608.40	3794591.
.07000	6184.0	608.30	3761727.
.07500	6118.0	608.20	3720968.
.08000	6041.0	608.10	3673532.
.08500	5988.0	608.00	3640704.
.09000	5966.0	608.00	3626720.
.09500	5939.0	607.90	3610318.
.10000	5902.0	607.90	3587826.
.11000	5819.0	607.80	3536788.
.12000	5714.0	607.60	3471826
.13000	5615.0	607.50	3411113.
.14000	5527.0	607.40	3357100.

(CONTINUED)

TABLE 6.2-14A (CONT.)
(Historical)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
.15000	5468.0	607.30	3320716.
.16000	5418.0	607.30	3290351.
.17000	5360.0	607.20	3254592.
.18000	5258.0	607.10	3192132.
.19000	5168.0	607.00	3136976.
.20000	5098.0	608.90	3093976.
.22000	5017.0	506.80	3044316.
.24000	4953.0	606.70	3004985.
.26000	4860.0	606.50	2947590.
.28000	4769.0	606.40	2888890.
.30000	4726.0	606.40	2865846.
.32000	4678.0	606.30	2836271.
.34000	4636.0	606.30	2810807.
.36000	4613.0	606.30	2796862.
.38000	4560.0	606.20	2764272.
.40000	4548.0	606.20	2756998.
.42000	4568.0	606.20	2767909.
.44000	4547.0	606.20	2756391.
.46000	4525.0	606.20	2743055.
.48000	4524.0	606.20	2742449.
.50000	4509.0	606.20	2731537.
.55000	4486.0	606.20	2719413.
.60000	4518.0	606.30	2739263.
.65000	4567.0	606.40	2769429.
.70000	4612.0	606.50	2797178.
.75000	4609.0	606.50	2795359.
.80000	4624.0	606.60	2804918.
.85000	4648.0	606.70	2819942.
.90000	4656.0	606.80	2825261.
.95000	4650.0	606.80	2821620.
1.00000	4651.0	606.90	2822692.
1.10000	4644.0	607.00	2818908.
1.20000	4825.0	607.10	2806623.
1.30000	4564.0	607.20	2789447.
1.40000	4590.0	507.30	2787507.
1.50000	4625.0	607.50	2808473.
1.60000	4601.0	607.60	2795564.
1.70000	4608.0	607.80	2800742.
1.80000	4597.0	607.90	2794516.
1.90000	4582.0	608.10	2786314.
2.00000	4567.0	608.20	2777649.
2.50000	4441.0	609.00	2704569.
3.00000	4271.0	609.90	2604883.
3.50000	4128.0	611.10	2522621.
4.00000	4013.0	612.50	2457963.

TABLE 6.2-14B
(Historical)
MASS/ENERGY RELEASE RATES FOR 100 SQ IN
HOT LEG GUILLOTINE BREAK AT RV NOZZLE
FOR CONTAINMENT SUBCOMPARTMENT ANALYSIS
(FLOW FROM SG SIDE)

Cycle 1

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
0.00000	0.0	609.10	0.
.00100	337.1	609.10	205328.
.00200	672.1	609.00	409309.
.00300	1005.0	609.00	610827.
.00400	1328.0	608.90	808619.
.00500	1647.0	608.80	1002694.
.00600	1959.0	608.80	1192639.
.00700	2268.0	608.70	1380532.
.00800	2577.0	608.70	1568620.
.00900	2888.0	608.60	1757637.
.01000	3200.0	608.60	1947520.
.01200	3837.0	608.60	2335198.
.01400	4494.0	608.60	2735048.
.01600	5151.0	608.70	3135414.
.01800	5789.0	608.70	3523764.
.02000	6400.0	608.60	3895040.
.02200	6371.0	608.60	3877391.
.02400	6383.0	608.60	3884694.
.02600	6425.0	608.70	3910898.
.02800	6463.0	608.70	3934028.
.03000	6482.0	608.70	3945593.
.03200	6478.0	608.70	3943159.
.03400	6480.0	608.70	3926115.
.03600	6416.0	608.60	3904778.
.03800	6392.0	608.60	3890171.
.04000	6382.0	608.60	3884085.
.04200	6388.0	608.60	3887737.
.04400	6402.0	608.60	3896257.
.04600	6413.0	608.60	3902952.
.04800	6413.0	608.60	3902952.
.05000	6402.0	608.60	3896257.
.05500	6345.0	608.60	3861567.
.06000	6289.0	608.50	3826857.
.06500	6224.0	608.40	3786682.
.07000	6157.0	608.30	3745303.
.07500	6079.0	608.20	3697248.
.08000	5977.0	608.10	3634614.
.08500	5935.0	608.00	3608480.
.09000	5961.0	608.10	3624884.
.09500	5973.0	608.10	3632181.
.10000	5971.0	608.10	3630965.
.11000	5900.0	608.00	3587200.
.12000	5757.0	607.80	3499105.
.13000	5571.0	607.60	3384940.
.14000	5496.0	607.50	3338020.

TABLE 6.2-14B (CONT.)

(Historical)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
.15000	5421.0	607.40	3292715.
.16000	5362.0	607.30	3256343.
.17000	5347.0	607.30	3247233.
.18000	5226.0	607.20	3173227.
.19000	5174.0	607.10	3141135.
.20000	5121.0	607.00	3108447.
.22000	5040.0	606.90	3058776.
.24000	4936.0	606.80	2995165.
.26000	4844.0	606.60	2938370.
.28000	4728.0	606.50	2867532.
.30000	4736.0	606.50	2872384.
.32000	4695.0	606.40	2874048.
.34000	4615.0	606.30	2798075.
.36000	4621.0	606.30	2801712.
.38000	4545.0	606.20	2755179.
.40000	4522.0	606.20	2741236.
.42000	4571.0	606.20	2770940.
.44000	4556.0	606.20	2761847.
.46000	4528.0	606.20	2744874.
.48000	4540.0	606.20	2752148.
.50000	4479.0	606.10	2714722.
.55000	4497.0	606.20	2726081.
.60000	4503.0	606.20	2729719.
.65000	4577.0	606.30	2775035.
.70000	4611.0	606.40	2796110.
.75000	4611.0	606.40	2796110.
.80000	4620.0	606.40	2801568.
.85000	4652.0	606.50	2821438.
.90000	4659.0	606.60	2826149.
.95000	4652.0	606.60	2821903.
1.00000	4655.0	606.60	2823723.
1.10000	4648.0	606.70	2819942.
1.20000	4628.0	606.80	2808270.
1.30000	4600.0	606.90	2791740.
1.40000	4593.0	607.00	2787951.
1.50000	4630.0	607.20	2811336.
1.60000	4607.0	607.30	2797831.
1.70000	4616.0	607.40	2803758.
1.80000	4604.0	607.50	2796930.
1.90000	4589.0	607.70	2788735.
2.00000	4575.0	607.80	2780685.
2.50000	4451.0	608.50	2708434.
3.00000	4284.0	609.30	2610241.
3.50000	4145.0	610.30	2529694.
4.00000	4032.0	611.60	2465971.

TABLE 6.2-15A

(Historical)

MASS/ENERGY RELEASE RATES FOR 200 SQ IN
DISCHARGE LEG GUILL. BREAK AT RV NOZZLE
FOR CONTAINMENT SUBCOMPARTMENT ANALYSIS
(FLOW FROM PUMP SIDE)
Cycle 1

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
0.00000	0.0	544.70	0.
.00100	4692.0	544.50	2554794.
.00200	8930.0	544.00	4857920.
.00300	11870.0	543.10	6446597.
.00400	12100.0	542.00	6558200.
.00500	10110.0	541.00	5469510.
.00600	8483.0	540.20	4582517.
.00700	7359.0	539.80	3972388.
.00800	6841.0	539.60	3691404.
.00900	6855.0	539.60	3698958.
.01000	7270.0	539.80	3924346.
.01200	8782.0	540.40	4745793.
.01400	10420.0	541.20	5639304.
.01600	11870.0	541.90	6432353.
.01800	12970.0	542.60	7037522.
.02000	13940.0	543.10	7570814.
.02200	14720.0	543.50	8000320.
.02400	15060.0	543.70	8188122.
.02600	15240.0	543.80	8287512.
.02800	15350.0	543.90	8348865.
.03000	15440.0	543.90	8397816.
.03200	15540.0	543.00	8453760.
.03400	15660.0	544.10	8530606.
.03600	15790.0	544.20	8592918.
.03800	15910.0	544.30	8659813.
.04000	15950.0	544.30	8681585.
.04200	15890.0	544.30	8648927.
.04400	15720.0	544.20	8554824.
.04600	15480.0	544.00	8421120.
.04800	15080.0	543.70	8198996.
.05000	14630.0	543.50	7951405.
.05500	13780.0	543.10	7483918.
.06000	13800.0	543.10	7494780.
.06500	14390.0	543.40	7819526.
.07000	14690.0	543.50	7984015.
.07500	14290.0	543.30	7763757.
.08000	13350.0	542.90	7247715.
.08500	12540.0	542.30	6800442.
.09000	12130.0	542.10	6575673.
.09500	12290.0	542.20	6663638.
.10000	12720.0	542.50	6900600.
.11000	12900.0	542.60	6999540.
.12000	12380.0	542.30	6713674.
.13000	11870.0	542.00	6433540.
.14000	10610.0	541.40	5852534.

(CONTINUED)

TABLE 6.2-15A (CONT.)

(Historical)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
.15000	10310.0	541.20	5579772.
.16000	10820.0	541.40	5857948.
.17000	10880.0	541.50	5891520.
.18000	10770.0	541.40	5830878.
.19000	11310.0	541.70	6126627.
.20000	11470.0	541.80	6214446.
.22000	10690.0	541.40	5787566.
.24000	10820.0	541.50	5859030.
.26000	10860.0	541.50	5880690.
.28000	11000.0	541.60	5957600.
.30000	11080.0	541.60	6006344.
.32000	10830.0	541.50	5864445.
.34000	10960.0	541.60	5935936.
.36000	11030.0	541.60	5973848.
.38000	11000.0	541.60	5957600.
.40000	10910.0	541.60	5908856.
.42000	10900.0	541.60	5903440.
.44000	11020.0	541.70	5969534.
.46000	10970.0	541.70	5942449.
.48000	10930.0	541.70	5920781.
.50000	11010.0	541.70	5964117.
.55000	10980.0	541.80	5948964.
.60000	11000.0	541.90	5960900.
.65000	11100.0	542.00	6016200.
.70000	10990.0	542.00	5956580.
.75000	10970.0	542.10	5946837.
.80000	11020.0	542.30	5976146.
.85000	10980.0	542.40	5955552.
.90000	11000.0	542.50	5967500.
.95000	11000.0	542.60	5968600.
1.00000	10990.0	542.80	5965372.
1.10000	10990.0	543.10	5968669.
1.20000	10990.0	543.40	5971966.
1.30000	10970.0	543.70	5964369.
1.40000	10960.0	544.10	5963336.
1.50000	10960.0	544.50	5967720.
1.60000	10960.0	544.90	5972104.
1.70000	10950.0	545.30	5971035.
1.80000	10930.0	545.70	5964561.
1.90000	10920.0	546.10	5963412.
2.00000	10890.0	546.50	5951385.
2.50000	10740.0	548.60	5891964.
3.00000	10530.0	550.50	5796765.
3.50000	10310.0	552.40	5695244.
4.00000	10030.0	554.30	5559629.

TABLE 6.2-15B

(Historical)
MASS/ENERGY RELEASE RATES FOR 200 SQ IN
DISCHARGE LEG GUILL. BREAK AT RV NOZZLE
FOR CONTAINMENT SUBCOMPARTMENT ANALYSIS
(FLOW FROM RV SIDE)
Cycle 1

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
0.00000	0.0	544.70	0.
.00100	4292.0	543.60	2333131.
.00200	6455.0	541.60	3496028.
.00300	8017.0	540.70	4334792.
.00400	9982.0	541.00	5400262.
.00500	12100.0	541.00	6558200.
.00600	13460.0	542.90	7307434.
.00700	13940.0	543.10	7570814.
.00800	13560.0	542.90	7361724.
.00900	13010.0	542.50	7057925.
.01000	12550.0	542.20	6804610.
.01200	12390.0	542.10	6716619.
.01400	12860.0	542.50	6976550.
.01600	13330.0	542.80	7235524.
.01800	13720.0	543.00	7449960.
.02000	14140.0	543.20	7680848.
.02200	14570.0	543.40	7917338.
.02400	14890.0	543.60	8094204.
.02600	15090.0	543.70	8204433.
.02800	15190.0	543.80	8260322.
.03000	15280.0	543.80	8309264.
.03200	15360.0	543.90	8354304.
.03400	15430.0	543.90	8392377.
.03600	15500.0	544.00	8432000.
.03800	15540.0	544.00	8453760.
.04000	15540.0	544.00	8453760.
.04200	15510.0	544.00	8437440.
.04400	15420.0	543.90	8386938.
.04600	15280.0	543.80	8309264.
.04800	15090.0	543.70	8204433.
.05000	14880.0	543.60	8088768.
.05500	14480.0	543.40	7868432.
.06000	14340.0	543.30	7790922.
.06500	14360.0	543.30	7801788.
.07000	14260.0	543.30	7747458.
.07500	13820.0	543.10	7505642.
.08000	13210.0	542.70	7169067.
.08500	12670.0	542.40	6872208.
.09000	12310.0	542.10	6673251.
.09500	12300.0	542.10	6667830.
.10000	12520.0	542.30	6789596.
.11000	12700.0	542.40	6888480.
.12000	12220.0	542.10	6624462.
.13000	11780.0	541.80	6382404.
.14000	11100.0	541.50	6010650.

(CONTINUED)

TABLE 6.2-15B (CONT.)

(Historical)

Cycle 1

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
.15000	10560.0	541.20	5715072.
.16000	10730.0	541.30	5808149.
.17000	10960.0	541.40	5933744.
.18000	11010.0	541.50	5961915.
.19000	11160.0	541.60	6044256.
.20000	11230.0	541.60	6082168.
.22000	10860.0	541.40	5879604.
.24000	10850.0	541.40	5874190.
.26000	10830.0	541.40	5863362.
.28000	11080.0	541.50	5999820.
.30000	11010.0	541.50	5961915.
.32000	10910.0	541.40	5906674.
.34000	11030.0	541.50	5972745.
.36000	10960.0	541.50	5934840.
.38000	11040.0	541.50	5978160.
.40000	10950.0	541.50	5929425
.42000	10920.0	541.50	5913180.
.44000	11000.0	541.50	5956500.
.46000	10980.0	541.50	5945670.
.48000	10970.0	541.50	5940255.
.50000	11010.0	541.50	5961915.
.55000	10990.0	541.50	5951085.
.60000	11000.0	541.50	5956500.
.65000	11110.0	541.60	6017176.
.70000	11020.0	541.60	5968432.
.75000	11020.0	541.60	5968432.
.80000	11050.0	541.60	5984680.
.85000	11020.0	541.60	5968432.
.90000	11040.0	541.60	5979264.
.95000	11040.0	541.70	5980368.
1.00000	11040.0	541.70	5980368.
1.10000	11050.0	541.80	5986890.
1.20000	11050.0	541.80	5986890.
1.30000	11050.0	541.90	5987995.
1.40000	11060.0	542.00	5994520.
1.50000	11070.0	542.20	6002154.
1.60000	11080.0	542.30	6008684.
1.70000	11080.0	542.40	6009792.
1.80000	11080.0	542.60	6012005.
1.90000	11070.0	542.80	6008796.
2.00000	11060.0	543.00	6005580.
2.50000	10950.0	544.00	5956800.
3.00000	10770.0	545.30	5872881.
3.50000	10560.0	546.90	5775264.
4.00000	10280.0	548.70	5640636.

TABLE 6.2-16A
(Historical)
MASS/ENERGY RELEASE RATES FOR 1000 SQ IN
HOT LEG GUILL. BREAK AT SG NOZZLE
FOR CONTAINMENT SUBCOMPARTMENT ANALYSIS
(FLOW FROM RV SIDE)

Cycle 1

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
0.00000	0.0	609.10	0.
.00100	5325.0	609.00	3242925.
.00200	10140.0	608.50	6170190.
.00300	13980.0	607.90	8498442.
.00400	16680.0	607.20	10128096.
.00500	18940.0	606.60	11489004.
.00600	20400.0	606.00	12362400.
.00700	22190.0	605.70	13440463.
.00800	25350.0	605.70	15354495.
.00900	28510.0	605.70	17268507.
.01000	31660.0	605.70	19176462.
.01200	37920.0	605.70	22968144.
.01400	39420.0	605.70	23876694.
.01600	39360.0	605.80	23844288.
.01800	39310.0	605.80	23813998.
.02000	39280.0	605.80	23795824.
.02200	39270.0	605.90	23793693.
.02400	39260.0	605.90	23787634.
.02600	39270.0	605.90	23793693.
.02800	39290.0	605.90	23805811.
.03000	39310.0	606.00	23821860.
.03200	39350.0	606.00	23846100.
.03400	39400.0	606.00	23876400.
.03600	39460.0	606.10	23916706.
.03800	39520.0	606.10	23953072.
.04000	39600.0	606.10	24001560.
.04200	39660.0	606.10	24037926.
.04400	45510.0	606.80	27615468.
.04600	47180.0	607.00	28638260
.04800	45680.0	606.80	27718624.
.05000	43830.0	606.60	26587278.
.05500	40110.0	606.20	24314682.
.06000	40050.0	606.20	24278310.
.06500	39660.0	606.10	24037926.
.07000	39640.0	606.00	24021840.
.07500	39600.0	606.00	23997600.
.00800	39510.0	606.00	23943060.
.08500	39380.0	606.00	23864280.
.09000	39220.0	605.90	23763398.
.09500	39060.0	605.90	23666454.
.10000	38880.0	606.80	23553504.
.11000	38500.0	605.80	23323300.
.12000	38100.0	605.70	23077170.
.13000	3770.0	605.70	22834890.
.14000	37360.0	605.60	22625216.

(CONTINUED)

TABLE 6.2-16A (CONT)

(Historical)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
.15000	37080.0	605.60	22455648
.16000	36870.0	605.50	22324785.
.17000	36720.0	605.50	22233960.
.18000	36600.0	605.50	22161300.
.19000	36460.0	605.50	22076530.
.20000	36320.0	605.50	21991760.
.22000	36020.0	605.50	21810110.
.24000	35620.0	605.50	21567910.
.26000	35030.0	605.50	21210665.
.28000	34290.0	605.50	20762595.
.30000	33580.0	605.50	20332690.
.32000	33100.0	605.50	20042050.
.34000	32840.0	605.60	19887904.
.36000	32650.0	605.60	19772840.
.38000	32390.0	605.70	19618623.
.40000	32010.0	605.80	19391658.
.42000	31590.0	605.80	19137222.
.44000	31240.0	605.90	18928316.
.46000	30990.0	606.00	18779940.
.48000	30810.0	606.10	18673941.
.50000	30130.0	606.10	18564843.
.55000	29870.0	606.30	18110181.
.60000	29100.0	606.50	17649150.
.65000	28570.0	606.80	17336276.
.70000	28400.0	607.30	17247320.
.75000	28230.0	607.80	17158194
.80000	28040.0	608.30	17056732.
.85000	27840.0	608.70	16946208.
.90000	27630.0	609.10	16829433.
.95000	27400.0	609.30	16694820.
1.00000	27160.0	609.60	16556736.
1.10000	26790.0	610.50	16355295.
1.20000	26340.0	611.60	16109544.
1.30000	25830.0	612.30	15815709.
1.40000	25390.0	612.70	15556453.
1.50000	24990.0	613.00	15318870.
1.60000	24600.0	613.50	15092100.
1.70000	24290.0	614.10	14916489.
1.80000	23980.0	614.50	14735710.
1.90000	23630.0	614.60	14522998.
2.00000	23320.0	614.80	14337136.
2.50000	22120.0	616.40	13634768.
3.00000	21360.0	617.20	13183392.
3.50000	20970.0	614.50	12886065.
4.00000	20870.0	611.00	12629370.

TABLE 6.2-16B
(Historical)
MASS/ENERGY RELEASE RATES FOR 1000 SQ IN
HOT LEG GUILL. BREAK AT SG NOZZLE
FOR CONTAINMENT SUBCOMPARTMENT ANALYSIS
(FLOW FROM SG SIDE)

Cycle 1

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
0.00000	0.0	609.10	0.
.00100	5044.0	608.50	3069274.
.00200	9611.0	608.10	5844449.
.00300	14580.0	608.20	8867556.
.00400	18050.0	607.70	10968985.
.00500	20410.0	607.00	12388870.
.00600	23080.0	606.60	14000328
.00700	25020.0	606.20	15167124.
.00800	26520.0	605.80	16065816.
.00900	28530.0	605.60	17277768.
.01000	31670.0	605.60	19179352.
.01200	37700.0	605.60	22831120.
.01400	38810.0	605.60	23503336.
.01600	38410.0	605.60	23261096
.01800	38090.0	605.50	23063495.
.02000	37870.0	605.50	22930285.
.02200	37770.0	605.50	22869735.
.02400	37770.0	605.50	22869735.
.02600	37860.0	605.60	22928016.
.02800	38030.0	605.60	23030968.
.03000	38250.0	605.60	23164200.
.03200	38490.0	605.60	23309544.
.03400	38730.0	605.70	23458761.
.03600	38950.0	605.70	23592015.
.03800	39140.0	605.70	23707098.
.04000	39280.0	605.70	23791896.
.04200	39360.0	605.70	23840352.
.04400	39420.0	605.80	23880636.
.04600	39620.0	605.80	24001796.
.04800	43160.0	606.20	26163592.
.05000	40520.0	606.00	24555120.
.05500	39610.0	605.90	23999699.
.06000	39170.0	605.90	23733103.
.06500	38460.0	605.90	23302914.
.07000	37730.0	605.90	22860607.
.07500	37230.0	605.90	22557657.
.08000	37070.0	605.90	22460713.
.08500	37170.0	605.90	22521303.
.09000	37340.0	605.90	22624306.
.09500	37400.0	605.90	22660660.
.10000	37320.0	605.90	22612188.
.11000	36990.0	605.80	22408542.
.12000	36810.0	605.80	22299498.
.13000	36800.0	605.80	22293440.
.14000	36790.0	605.70	22283703.

(CONTINUED)

TABLE 6.2-16B (CONT.)

(Historical)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
.15000	36670.0	605.70	22211019.
.16000	36430.0	605.60	22862008.
.17000	36660.0	605.60	21837935.
.18000	35640.0	605.50	21580020.
.19000	35420.0	605.50	21446810.
.20000	35370.0	605.50	21416535.
.22000	34420.0	605.50	21144060.
.24000	34120.0	605.40	20656248.
.26000	33340.0	605.40	20186036.
.28000	32760.0	605.40	19645012.
.30000	32530.0	605.40	19683662.
.32000	32190.0	605.50	19491045.
.34000	31760.0	605.50	19230660.
.36000	31230.0	605.50	18909765.
.38000	30720.0	605.60	18604032.
.40000	30320.0	605.60	18361702.
.42000	30005.0	605.70	18261265.
.44000	29620.0	605.80	18060955.
.46000	29590.0	605.90	17928581.
.48000	29320.0	605.90	17764968.
.50000	28890.0	606.00	17567940.
.55000	28520.0	606.20	1728824.
.60000	28380.0	606.40	17209632.
.65000	28830.0	606.70	17127141.
.70000	28650.0	607.10	17035226.
.75000	27870.0	607.50	16931025.
.80000	27870.0	608.00	16823366.
.85000	27460.0	608.50	16709410.
.90000	27230.0	608.90	16580347.
.95000	26990.0	609.20	16442308.
1.00000	26700.0	609.50	16273650.
1.10000	26630.0	610.30	16068169.
1.20000	25760.0	611.40	15749664.
1.30000	25250.0	612.20	15458050.
1.40000	24830.0	612.80	15210858.
1.50000	24440.0	612.90	14979276.
1.60000	24050.0	613.40	14752270.
1.70000	23750.0	614.60	14588641.
1.80000	23460.0	614.40	14426112.
1.90000	23150.0	614.60	14227990.
2.00000	22850.0	615.70	14045895.
2.50000	21741.0	615.90	13389666.
3.00000	21000.0	616.30	12942300.
3.50000	20840.0	616.90	12731156.
4.00000	20590.0	600.40	12485776.

TABLE 6.2-17A
(Historical)
MASS/ENERGY RELEASE RATES FOR 1400 SQ IN
SUCTION LEG GUILL. BREAK AT SG NOZZLE
FOR CONTAINMENT SUBCOMPARTMENT ANALYSIS
(FLOW FROM SG SIDE)

Cycle 1

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
0.00000	0.0	544.70	0.
.00100	11140.0	544.50	6065730.
.00200	21050.0	543.90	11449095.
.00300	27890.0	543.10	15147059.
.00400	32390.0	542.00	17555380.
.00500	33170.0	541.00	17944970.
.00600	31760.0	540.20	17156752.
.00700	33290.0	539.90	17973271.
.00800	38040.0	539.90	20537796.
.00900	42780.0	539.90	23096922.
.01000	47530.0	540.00	25666200.
.01200	47550.0	540.00	25677000.
.01400	47580.0	540.00	25693200.
.01600	50440.0	540.20	27247688.
.01800	53010.0	540.40	28646604.
.02000	53030.0	540.40	28657412.
.02200	52770.0	540.50	28522185.
.02400	52820.0	540.50	28549210.
.02600	52930.0	540.50	28608685.
.02800	52710.0	540.50	28489755.
.03000	52050.0	540.50	28133025.
.03200	51370.0	540.50	27765485.
.03400	51280.0	540.60	27721968.
.03600	51900.0	540.60	28057140.
.03800	52740.0	540.70	28516518.
.04000	53150.0	540.80	28743520.
.04200	53050.0	540.80	28689440.
.04400	52980.0	540.80	28651584.
.04600	53680.0	540.90	29035512.
.04800	55620.0	541.10	30095982.
.05000	58290.0	541.30	31552377.
.05500	63190.0	541.70	34230023.
.06000	66000.0	542.00	35772000.
.06500	67960.0	542.20	36847912.
.07000	68190.0	542.30	36979437.
.07500	64920.0	542.20	35199624.
.08000	61730.0	542.10	33463833.
.08500	62740.0	542.30	34023902.
.09000	61400.0	542.30	33297220.
.09500	60190.0	542.30	32641037.
.10000	59800.0	542.40	32435520.
.11000	62550.0	542.80	33952140.
.12000	63330.0	543.00	34388190.
.13000	62440.0	543.20	33917408.
.14000	61730.0	543.40	33544082.

(CONTINUED)

TABLE 6.2-17A (CONT.)

(Historical)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
.15000	62200.0	543.70	33818140.
.16000	62400.0	543.90	33939360.
.17000	62600.0	544.10	34060660.
.18000	61720.0	544.30	33594196.
.19000	62670.0	544.60	34130082.
.20000	60800.0	544.70	33008820.
.22000	59340.0	545.10	32346234.
.24000	61890.0	545.80	33779562.
.26000	59980.0	546.10	32755078.
.28000	50400.0	546.60	33014640.
.30000	59240.0	547.10	32410204.
.32000	60040.0	547.60	32877904.
.34000	58520.0	548.50	32068960.
.36000	59230.0	548.90	32487655.
.38000	57820.0	548.90	31737398.
.40000	59090.0	549.50	32469955.
.42000	57270.0	549.90	31492773.
.44000	57840.0	550.40	31835136.
.46000	56480.0	550.80	31109184.
.48000	56930.0	551.30	31385509.
.50000	56620.0	551.70	31237254.
.55000	55740.0	552.80	30813072.
.60000	54680.0	553.80	30281784.
.65000	54220.0	554.80	30081256.
.70000	53500.0	555.60	29724600.
.75000	52750.0	556.40	29350100.
.80000	52310.0	557.20	29147132.
.85000	51900.0	557.80	28949820.
.90000	51330.0	558.40	28662872.
.95000	50770.0	559.00	28380430.
1.00000	50220.0	559.50	28098090.
1.10000	50000.0	560.40	28020000.
1.20000	48920.0	561.00	27444120.
1.30000	47600.0	561.60	26732160.
1.40000	46290.0	562.20	26024238.
1.50000	45100.0	562.80	25382280.
1.60000	44020.0	563.40	24800868.
1.70000	42960.0	564.10	24233736.
1.80000	41870.0	564.80	23648176.
1.90000	40790.0	565.50	23066745.
2.00000	39770.0	566.20	22517774.
2.50000	36280.0	570.50	20697740.
3.00000	34890.0	577.30	20141997.
3.50000	32940.0	589.80	19428012.
4.00000	30890.0	602.30	18484587.

TABLE 6.2-17B

(Historical)
MASS/ENERGY RELEASE RATES FOR 1400 SQ IN
SUCTION LEG GUILL. BREAK AT SG NOZZLE
FOR CONTAINMENT SUBCOMPARTMENT ANALYSIS
(FLOW FROM PUMP SIDE)

Cycle 1

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
0.00000	0.0	544.70	0.
.00100	11010.0	544.40	5993844.
.00200	19630.0	543.50	10668905.
.00300	25280.0	542.20	13706816.
.00400	26470.0	541.00	14320270.
.00500	24900.0	540.00	13446000.
.00600	28510.0	539.80	15389698.
.00700	33240.0	539.80	17942952.
.00800	37950.0	539.80	20485410.
.00900	42640.0	539.80	23017072.
.01000	47300.0	539.80	25532540.
.01200	46940.0	539.80	25338212.
.01400	46590.0	539.80	25149282.
.01600	46240.0	539.80	24960352.
.01800	45890.0	539.80	24771422.
.02000	45540.0	539.80	24582492.
.02200	45190.0	539.70	24389043.
.02400	44830.0	539.70	24194751.
.02600	44480.0	539.70	24005856.
.02800	44130.0	539.70	23816961.
.03000	43780.0	539.70	23628066.
.03200	43440.0	539.70	23444588.
.03400	43100.0	539.70	23261070.
.03600	42760.0	539.70	23077572.
.03800	42440.0	539.70	22904868.
.04000	42120.0	539.70	22732164.
.04200	41800.0	539.70	22559460.
.04400	41490.0	539.70	22392153.
.04600	41190.0	539.70	22230243.
.04800	40890.0	539.70	22068333.
.05000	40590.0	539.60	21902364.
.05500	39860.0	539.60	21508456.
.06000	39140.0	539.60	21119944.
.06500	38430.0	539.60	20736828.
.07000	37720.0	539.60	20353712.
.07500	37030.0	539.60	19981388.
.08000	36340.0	539.60	19609064.
.08500	36190.0	539.60	19528124.
.09000	36030.0	539.60	19441788.
.09500	35860.0	539.60	19350056.
.10000	35670.0	539.50	19243965.
.11000	35220.0	539.50	19001190.
.12000	34670.0	539.50	18704465.
.13000	34030.0	539.50	18359185.
.14000	33250.0	539.50	17938375.

(CONTINUED)

TABLE 6.2-17B (CONT.)

(Historical)

TIME (SECONDS)	FLOWRATE (LB/SEC)	ENTHLAY (BTU/LB)	ENERGY RATE (BTU/SEC)
.15000	32620.0	539.50	17598490.
.16000	32310.0	539.60	17434476.
.17000	32040.0	539.60	17288784.
.18000	31750.0	539.60	17132300.
.19000	31410.0	539.60	16948836.
.20000	31040.0	539.60	16749184.
.22000	30390.0	539.70	16401483.
.24000	29840.0	539.80	16107632.
.26000	29270.0	539.80	15799946.
.28000	28700.0	539.90	15495130.
.30000	28130.0	539.90	15187387.
.32000	27580.0	540.00	14893200.
.34000	27080.0	540.10	14625908.
.36000	26560.0	540.10	14345056.
.38000	26050.0	540.20	14072210.
.40000	25590.0	540.30	13826277.
.42000	25180.0	540.30	13804754.
.44000	24800.0	540.40	13401920.
.46000	24450.0	540.50	13215225.
.48000	24110.0	540.50	13031455.
.50000	23830.0	540.60	12882498.
.55000	22970.0	540.70	12419879.
.60000	22290.0	540.80	12054432.
.65000	21650.0	540.90	11710485.
.70000	21030.0	541.00	11377230.
.75000	20450.0	541.10	11065495.
.80000	19900.0	541.10	10767890.
.85000	19400.0	541.20	10499280.
.90000	18950.0	541.30	10257635.
.95000	18550.0	541.30	10041115.
1.00000	18190.0	541.40	9848066.
1.10000	17650.0	541.50	9557475.
1.20000	17300.0	541.60	9369680.
1.30000	17050.0	541.70	9235985.
1.40000	16800.0	541.80	9102240.
1.50000	16560.0	541.80	8972208.
1.60000	16360.0	541.90	8865484.
1.70000	16200.0	542.00	8780400.
1.80000	16040.0	542.00	8683680.
1.90000	15880.0	542.10	8608548.
2.00000	15720.0	542.30	8524956.
2.50000	15020.0	543.00	8155860.
3.00000	14570.0	544.20	7928994.
3.50000	14010.0	545.80	7646658.
4.00000	12980.0	547.90	7111742.

TABLE 6.2-18A
(Historical)
MASS/ENERGY RELEASE RATES FOR 1400 SQ IN
SUCTION LEG GUILL. BREAK AT PUMP NOZZLE
FOR CONTAINMENT SUBCOMPARTMENT ANALYSIS
(FLOW FROM SG SIDE)

Cycle 1

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
0.00000	0.0	544.70	0.
.00100	10870.0	544.20	5915454.
.00200	17990.0	542.80	9764972.
.00300	18930.0	540.80	10237344.
.00400	19000.0	539.80	10256200.
.00500	23720.0	539.80	12804056.
.00600	28410.0	539.80	15335718.
.00700	33060.0	539.90	17849094.
.00800	37640.0	539.90	20321836.
.00900	42170.0	539.90	22767583.
.01000	46060.0	539.90	25191734.
.01200	46360.0	539.90	25029764.
.01400	46090.0	539.90	24883991.
.01600	45840.0	539.90	24749016.
.01800	45600.0	540.00	24624000.
.02000	45380.0	540.00	24505200.
.02200	45180.0	540.00	24397200.
.02400	44990.0	540.10	24299099.
.02600	44820.0	540.10	24207282.
.02800	44670.0	540.10	24126267.
.03000	44530.0	540.10	24050653.
.03200	44400.0	540.20	23984880.
.03400	44280.0	540.20	23920056.
.03600	44180.0	540.20	23866036.
.03800	44090.0	540.20	23817418.
.04000	44000.0	540.30	23773200.
.04200	43930.0	540.30	23735379.
.04400	43870.0	540.30	23702961.
.04600	43820.0	540.30	23675946.
.04800	43770.0	540.30	23648931.
.05000	43730.0	540.40	23631692.
.05500	43670.0	540.40	23599268.
.06000	43650.0	540.40	23588460.
.06500	43660.0	540.50	23598230.
.07000	43690.0	540.50	23614445.
.07500	43740.0	540.50	23641470.
.08000	43810.0	540.60	23683686.
.08500	43980.0	540.60	23732340.
.09000	44020.0	540.70	23801614.
.09500	44160.0	540.70	23973664.
.10000	44330.0	540.80	23973664
.11000	44750.0	541.00	24209750.
.12000	45260.0	541.10	24490186.
.13000	45830.0	541.30	24807779.
.14000	46430.0	541.40	25137202.

(CONTINUED)

TABLE 6.2-18A (CONT)

(Historical)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
.15000	47000.0	541.50	25472160.
.16000	47630.0	541.70	25801171.
.17000	59510.0	542.50	32284175.
.18000	59730.0	542.70	32415471.
.19000	58200.0	542.80	32676560.
.20000	60020.0	542.90	32584858.
.22000	59270.0	543.10	32189537.
.24000	59400.0	543.40	32277960.
.26000	59990.0	543.90	32628561.
.28000	59250.0	544.10	32237925.
.30000	58840.0	544.50	32038380.
.32000	58430.0	544.90	31838507.
.34000	58760.0	545.30	32041828.
.36000	57980.0	545.70	31639686.
.38000	57910.0	546.10	31624651.
.40000	57680.0	546.50	31511190.
.42000	57450.0	546.90	31419405.
.44000	56980.0	547.40	31190852.
.46000	56590.0	547.80	31000002.
.48000	56350.0	548.20	30891070.
.50000	56280.0	548.60	30875208.
.55000	55450.0	579.70	30480865.
.60000	54710.0	550.70	30128797.
.65000	54030.0	551.70	29808351.
.70000	53520.0	552.70	29580504.
.75000	53040.0	553.70	29368248.
.80000	52410.0	554.50	29061345.
.85000	51840.0	555.40	28791936.
.90000	51430.0	556.20	28605366.
.95000	50980.0	556.90	28390762.
1.00000	50460.0	557.60	28136496
1.10000	49830.0	558.80	27845004.
1.20000	49200.0	559.70	27537240.
1.30000	48170.0	560.50	26999285.
1.40000	46870.0	561.10	26298757.
1.50000	45480.0	561.70	25546116.
1.60000	44210.0	562.30	24859283.
1.70000	43130.0	562.90	24277877.
1.80000	42170.0	563.60	23767012.
1.90000	41220.0	564.20	23256324.
2.00000	40240.0	564.90	22731576.
2.50000	36270.0	568.80	20630376.
3.00000	34900.0	574.70	20057030
3.50000	33230.0	585.30	19449519.
4.00000	30090.0	601.80	18108162.

TABLE 6.2-18B
(Historical)
MASS/ENERGY RELEASE RATES FOR 1400 SQ IN
SUCTION LEG GUILL BREAK AT PUMP NOZZLE
FOR CONTAINMENT SUBCOMPARTMENT ANALYSIS
(FLOW FROM PUMP SIDE)

Cycle 1

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
0.00000	0.0	544.70	0.
.00100	10220.0	543.70	5556614.
.00200	15360.0	541.70	8320512.
.00300	15250.0	540.00	8235000.
.00400	19000.0	539.80	10256200.
.00500	23720.0	539.80	12804056.
.00600	28420.0	539.80	15341116.
.00700	33070.0	539.80	17851186.
.00800	37630.0	539.80	20312674.
.00900	42110.0	539.80	22730978.
.01000	46470.0	539.80	25084506.
.01200	45520.0	539.80	24571696.
.01400	44550.0	539.70	24043635.
.01600	43550.0	539.70	23503935.
.01800	42500.0	539.70	22937250.
.02000	41420.0	539.60	22350232.
.02200	40300.0	539.60	21745880.
.02400	39160.0	539.50	21126820.
.02600	38040.0	539.50	20522580.
.02800	36960.0	539.50	19939920.
.03000	36260.0	539.50	19562270.
.03200	36070.0	539.50	19459765.
.03400	35880.0	539.60	19360848.
.03600	35690.0	539.60	19258324.
.03800	35510.0	539.70	19164747.
.04000	35310.0	539.70	19056807.
.04200	35100.0	539.80	18946980.
.04400	34870.0	539.80	18822826.
.04600	34800.0	539.80	18677080.
.04800	34290.0	539.80	18509742.
.05000	33950.0	539.80	18326210.
.05500	32990.0	539.90	17811301.
.06000	32540.0	540.10	17574854.
.06500	32290.0	540.30	17446287.
.07000	32040.0	540.40	17314416.
.07500	31750.0	540.40	17157700.
.08000	31400.0	540.50	16971700.
.08500	30930.0	540.50	16717665.
.09000	30580.0	540.50	16528490.
.09500	30190.0	540.40	16314646.
.10000	29750.0	540.40	16076900.
.11000	28760.0	540.20	15536152.
.12000	27890.0	540.20	15066178.
.13000	27160.0	540.20	14671832.
.14000	26460.0	540.20	14293692.

(CONTINUED)

TABLE 6.2-18B (CONT)

(Historical)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
.15000	25820.0	540.30	13950546.
.16000	25450.0	540.50	13755725.
.17000	25370.0	540.80	13720096.
.18000	25160.0	540.90	13609044.
.19000	24830.0	540.90	13430547.
.20000	24590.0	540.90	13300731.
.22000	23970.0	540.80	12962976.
.24000	23950.0	541.10	12959345.
.26000	23960.0	541.20	12967152.
.28000	24060.0	541.40	13026084.
.30000	23710.0	541.20	12831852.
.32000	23600.0	541.30	12774680.
.34000	23620.0	541.40	12787868.
.36000	23500.0	541.30	12720550.
.38000	23290.0	541.30	12606877.
.40000	23060.0	541.30	12482378.
.42000	22960.0	541.40	12430544.
.44000	22740.0	541.40	12311436.
.46000	22430.0	541.30	12141359.
.48000	22180.0	541.40	12008252.
.50000	22080.0	541.40	11943264.
.55000	21480.0	541.40	11629272.
.60000	20990.0	541.50	11366085.
.65000	20450.0	541.50	11073675.
.70000	20070.0	541.60	10869912.
.75000	19710.0	541.70	10676907.
.80000	19340.0	541.70	10476478.
.85000	19020.0	541.70	10303134.
.90000	18730.0	541.80	10147914.
.95000	18450.0	541.80	9996210.
1.00000	18210.0	541.90	9867999.
1.10000	17850.0	542.00	9674700.
1.20000	17630.0	542.10	9557223.
1.30000	17430.0	542.20	9450546.
1.40000	17170.0	542.20	9309574.
1.50000	16920.0	542.30	9175716.
1.60000	16710.0	542.40	9063504.
1.70000	16520.0	542.50	8962100.
1.80000	16380.0	542.60	8887788.
1.90000	16240.0	542.70	8813448.
2.00000	16090.0	542.80	8733652.
2.50000	15420.0	543.60	8382312.
3.00000	14990.0	544.80	8166552.
3.50000	14390.0	546.60	7865574.
4.00000	13290.0	549.00	7296210.

TABLE 6.2-19
(Historical)
MASS/ENERGY RELEASE RATES FOR 532 SQ IN
SUCTION LEG SLOT BREAK
FOR CONTAINMENT SUBCOMPARTMENT ANALYSIS

Cycle 1

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
0.00000	0.0	544.70	0.
.00100	16530.0	544.20	8995626.
.00200	27930.0	542.90	15163197.
.00300	33450.0	541.50	18113175.
.00400	33770.0	540.30	18245931.
.00500	36140.0	539.80	19508372.
.00600	36130.0	539.90	19506587.
.00700	36140.0	539.90	19511986.
.00800	39770.0	540.20	21483754.
.00900	43360.0	540.50	23436080.
.01000	45120.0	540.60	24391872.
.01200	45050.0	540.60	24354030.
.01400	44000.0	540.50	23782000.
.01600	44111.0	540.50	24245910.
.01800	44850.0	540.60	24391872.
.02000	45120.0	540.60	24391872.
.02200	44970.0	540.60	24310782.
.02400	45220.0	540.60	24445932.
.02600	45950.0	540.70	24845165.
.02800	46300.0	540.70	25034410.
.03000	45850.0	540.70	24791095.
.03200	45260.0	540.60	24467556.
.03400	45550.0	540.70	24628885.
.03600	46820.0	540.80	25320256.
.03800	48020.0	540.90	25974018.
.04000	48530.0	540.90	26249877.
.04200	48800.0	541.00	26400800.
.04400	49950.0	541.10	27027945.
.04600	52310.0	541.30	28315403.
.04800	54890.0	541.60	29728424.
.05000	56450.0	541.70	30578905.
.05500	58000.0	541.90	31430200.
.06000	60470.0	542.20	32786834.
.06500	60750.0	542.20	32938650.
.07000	59590.0	542.10	32303739.
.07500	56060.0	541.80	30373308.
.08000	57830.0	542.00	31343800.
.08500	53120.0	541.60	28769792.
.09000	49530.0	541.30	26810589.
.09500	49940.0	541.30	27032522.
.10000	54990.0	541.80	29793582.
.11000	58370.0	542.20	31648214.
.12000	56780.0	542.10	30780438.
.13000	49660.0	541.60	26895856.
.14000	50410.0	541.70	27307097.

(CONTINUED)

TABLE 6.2-19 (CONT)

(Historical)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
.15000	52850.0	542.00	28644700.
.16000	52700.0	542.10	28568670.
.17000	52350.0	542.10	28378935.
.18000	52800.0	542.30	28655132.
.19000	52840.0	542.30	28655132.
.20000	58840.0	542.30	27570532.
.22000	49270.0	542.30	26719121.
.24000	52860.0	542.80	28692408.
.26000	51550.0	542.90	27986495.
.28000	50500.0	543.00	27421500.
.30000	50330.0	543.20	27339256.
.32000	49770.0	543.30	27044041.
.34000	51040.0	543.70	27750448.
.36000	50410.0	543.80	27412958.
.38000	49270.0	543.90	26797953.
.40000	49410.0	544.10	26883981.
.42000	49650.0	544.40	27029460.
.44000	49440.0	544.50	26920080.
.46000	49280.0	544.70	26842816.
.48000	48710.0	544.90	26542079.
.50000	49110.0	545.10	26769861.
.55000	48350.0	545.50	26374925.
.60000	48340.0	546.00	26393640.
.65000	47800.0	546.40	26117920.
.70000	47790.0	546.90	26136351.
.75000	47560.0	547.30	26029588.
.80000	47300.0	547.70	25906210.
.85000	47180.0	548.00	25854640.
.90000	46920.0	548.40	25730928.
.95000	46740.0	548.80	25650912.
1.00000	46520.0	549.10	25544132.
1.10000	46170.0	549.80	25384266.
1.20000	45890.0	550.40	25257856.
1.30000	45590.0	550.90	25115531.
1.40000	45420.0	551.40	25044588.
1.50000	45260.0	551.80	24974468.
1.60000	45060.0	552.30	24886638.
1.70000	44880.0	552.60	24800688.
1.80000	44690.0	553.00	24713570.
1.90000	44430.0	553.30	24583119.
2.00000	44290.0	553.70	24523373.
2.50000	42150.0	555.30	23739075.
3.00000	41220.0	557.30	22971906.
3.50000	39850.0	560.30	22327955.
4.00000	38300.0	564.70	21628010.

TABLE 6.2-20A
(Historical)
MASS/ENERGY RELEASE RATES FOR 1400 SQ IN
DISCHARGE LEG GUILL BREAK AT PUMP NOZZLE
FOR CONTAINMENT SUBCOMPARTMENT ANALYSIS
(FLOW FROM PUMP SIDE)

Cycle 1

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
0.00000	0.0	544.70	0.
.00100	10680.0	543.70	5806716.
.00200	15810.0	541.60	8562696.
.00300	15210.0	539.70	8208837.
.00400	18940.0	539.50	10218130.
.00500	23640.0	539.60	12756144.
.00600	28290.0	539.60	15265284.
.00700	32890.0	539.60	17736652.
.00800	37390.0	539.60	20175644.
.00900	41820.0	539.60	22566072.
.01000	46150.0	539.70	24907155.
.01200	45520.0	539.70	24567144.
.01400	44910.0	539.70	24237927.
.01600	44280.0	539.70	23897916.
.01800	43640.0	539.70	23552508.
.02000	43000.0	539.70	23207100.
.02200	42360.0	539.70	22861692.
.02400	41720.0	539.80	22520456.
.02600	41110.0	539.80	22191178.
.02800	40530.0	539.90	21882147.
.03000	39980.0	539.90	21585202.
.03200	39460.0	540.00	21308400.
.03400	38970.0	540.10	21047697.
.03600	38490.0	540.10	20788449.
.03800	38010.0	540.20	20533002.
.04000	37540.0	540.20	20279108.
.04200	37060.0	540.30	20023518.
.04400	36570.0	540.30	19758771.
.04600	36250.0	540.30	19585875.
.04800	36150.0	540.40	19535460.
.05000	36030.0	540.40	19470612.
.05500	35740.0	540.50	19317470.
.06000	35380.0	540.60	19126428.
.06500	34990.0	540.70	18919093.
.07000	34510.0	540.80	18663008.
.07500	33880.0	540.80	18322304.
.08000	33000.0	540.80	17846400.
.08500	32480.0	540.80	17565184.
.09000	32100.0	540.80	17359680.
.09500	31700.0	540.80	17143360.
.10000	31110.0	540.70	16821177.
.11000	30200.0	540.50	16323100.
.12000	29210.0	540.40	15785084.
.13000	28320.0	540.40	15304128.
.14000	27550.0	540.40	14888020.

(CONTINUED)

TABLE 6.2-20A (CONT)

(Historical)

TIME (SECONDS)	FLOW.RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
.15000	26910.0	540.50	14544855.
.16000	26480.0	540.70	14306922.
.17000	26100.0	540.80	14114880.
.18000	25690.0	540.90	13895721.
.19000	25340.0	541.00	13708940.
.20000	24990.0	541.00	13519590.
.22000	24440.0	541.20	13226928.
.24000	24140.0	541.40	13069396.
.26000	23930.0	541.50	12958095.
.28000	23600.0	541.60	12781760.
.30000	23260.0	541.70	12599942.
.32000	22930.0	541.70	12421181.
.34000	22520.0	541.90	12203588.
.36000	22560.0	542.00	12119120.
.38000	22010.0	542.00	11929420.
.40000	21720.0	542.10	11774412.
.42000	21440.0	542.20	11624768.
.44000	21160.0	542.30	11475068.
.46000	20760.0	542.30	11258148.
.48000	20410.0	542.40	11070384.
.50000	20160.0	542.60	10938816.
.55000	19640.0	542.90	10662556.
.60000	19210.0	543.20	10434872.
.65000	18890.0	543.60	10268604.
.70000	18650.0	543.90	10143735.
.75000	18380.0	544.30	10004234.
.80000	18110.0	544.60	9862706.
.85000	17850.0	544.90	9726465.
.90000	17610.0	545.30	9602733.
.95000	17350.0	545.60	9466160.
1.00000	17080.0	545.90	9323972.
1.10000	16580.0	546.80	9051696.
1.20000	16230.0	547.30	8882679.
1.30000	15780.0	547.90	8645862.
1.40000	15340.0	548.50	8413990.
1.50000	15000.0	549.20	8238000.
1.60000	14750.0	549.80	8109550.
1.70000	14430.0	550.30	7940829.
1.80000	14190.0	550.90	7817271.
1.90000	14010.0	551.40	7725114.
2.00000	13830.0	551.90	7632777.
2.50000	13250.0	554.00	7340500.
3.00000	14200.0	555.90	7893780.
3.50000	14930.0	558.50	8338405.
4.00000	15580.0	562.80	8768424.

TABLE 6.2-20B
(Historical)
MASS/ENERGY RELEASE RATES FOR 1400 SQ IN
DISCHARGE LEG GUILL BREAK AT PUMP NOZZLE
FOR CONTAINMENT SUBCOMPARTMENT ANALYSIS
(FLOW FROM RV SIDE)

Cycle 1

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
0.00000	0.0	544.70	0.
.00100	11080.0	544.10	6028628.
.00200	18070.0	542.50	9802975.
.00300	18280.0	540.30	9876684.
.00400	18930.0	539.50	10212735.
.00500	23030.0	539.50	12748385.
.00600	28260.0	539.50	15246270.
.00700	32850.0	539.50	17722575.
.00800	37380.0	539.50	20166510.
.00900	41860.0	539.50	22583470.
.01000	46270.0	539.50	24962665.
.01200	45710.0	539.40	24655974.
.01400	45180.0	539.40	24370092.
.01600	44660.0	539.40	24089604.
.01800	44170.0	539.40	23825298.
.02000	43690.0	539.40	23566386.
.02200	43230.0	539.40	23318262.
.02400	42790.0	539.50	23085205.
.02600	42380.0	539.50	22864010.
.02800	42000.0	539.50	22659000.
.03000	41640.0	539.50	22464780.
.03200	41320.0	539.60	22296272.
.03400	41020.0	539.60	22134392.
.03600	40750.0	539.60	21988700.
.03800	40520.0	539.70	21868644.
.04000	40320.0	539.70	21760704.
.04200	40140.0	539.80	21667572.
.04400	40000.0	539.80	21592000.
.04600	39880.0	539.90	21531212.
.04800	39800.0	539.90	21488020.
.05000	39740.0	540.00	21459600.
.05500	39700.0	540.10	21441970.
.06000	39810.0	540.30	21509343.
.06500	40040.0	540.40	21637616.
.07000	40350.0	540.50	21809175.
.07500	40730.0	540.60	22018638.
.08000	41140.0	540.60	22240284.
.08500	41550.0	540.60	22461930.
.09000	41960.0	540.60	22683576.
.09500	42370.0	540.60	22905222.
.10000	42780.0	540.70	23131146.
.11000	43640.0	540.70	23596148.
.12000	44550.0	540.80	24092640.
.13000	45470.0	540.90	24594723.
.14000	46390.0	540.90	25092351.

(CONTINUED)

TABLE 6.2-20B (Cont.)

(Historical)

TIME (SECONDS)	FLOW.RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
.15000	47330.0	541.10	25610263.
.16000	64470.0	542.10	34949187.
.17000	63760.0	542.00	34557920.
.18000	62720.0	541.80	33981696.
.19000	62140.0	541.70	33661238.
.20000	61360.0	541.50	33226440.
.22000	61040.0	541.40	33047056.
.24000	61310.0	541.40	33193234.
.26000	60880.0	541.40	32960432.
.28000	60520.0	541.30	32759476.
.30000	59810.0	541.20	32369172.
.32000	60140.0	541.30	32553782.
.34000	60030.0	541.30	32494239.
.36000	59330.0	541.20	32109396.
.38000	59220.0	541.20	32049864.
.40000	59150.0	541.30	32017895.
.42000	59330.0	541.30	32115329.
.44000	58770.0	541.30	31812201.
.46000	58380.0	541.30	31601094.
.48000	58380.0	541.30	31601094.
.50000	58250.0	541.40	31536550.
.55000	57660.0	541.40	31217124.
.60000	57090.0	541.50	30914235.
.65000	56900.0	541.70	30822730.
.70000	56200.0	541.80	30470832.
.75000	55760.0	541.90	30216344.
.80000	55350.0	542.10	30005235.
.85000	54820.0	542.30	29728886.
.90000	54390.0	542.50	29506575.
.95000	53970.0	542.70	29289519.
1.00000	53580.0	542.90	29088582.
1.10000	52830.0	543.40	28707822.
1.20000	51980.0	543.90	28271922.
1.30000	51050.0	544.40	27791620.
1.40000	50270.0	545.00	27397150.
1.50000	49900.0	545.60	27225440.
1.60000	49380.0	546.20	26971356.
1.70000	48780.0	546.80	26672904.
1.80000	48410.0	547.30	26494793.
1.90000	48120.0	547.90	26364948.
2.00000	47440.0	548.30	26011352.
2.50000	43830.0	550.10	24110883.
3.00000	40930.0	551.30	22564709.
3.50000	37330.0	553.00	20643490.
4.00000	35990.0	554.70	19963653.

TABLE 6.2-21A

MASS/ENERGY RELEASE RATES FOR 161 SQ IN
SURGE LINE GUIL BREAK AT PRESS. NOZZLE
FOR CONTAINMENT SUBCOMPARTMENT ANALYSIS
(FLOW FROM HOT LEG SIDE)

Cycle 1

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
0.00000	0.0	700.70	0.
.00100	7057.0	700.60	4944134.
.00200	6676.0	700.30	4675203.
.00300	6331.0	700.00	4431700.
.00400	6017.0	699.60	4209493.
.00500	5732.0	699.30	4008388.
.00600	5530.0	698.90	3864917.
.00700	5394.0	698.40	3767170.
.00800	5263.0	697.90	3673048.
.00900	5137.0	697.40	3582544.
.01000	5016.0	696.90	3495650.
.01200	4770.0	695.70	3318489.
.01400	4564.0	694.50	3169698.
.01600	4375.0	693.30	3033188.
.01800	4229.0	692.30	2927737.
.02000	4131.0	691.50	2856587.
.02200	4079.0	691.10	2818997.
.02400	4067.0	690.90	2809890.
.02600	4088.0	691.00	2824808.
.02800	4135.0	691.10	2857699.
.03000	4198.0	691.30	2902077.
.03200	4269.0	691.50	2952014.
.03400	4330.0	691.40	2993762.
.03600	4368.0	691.00	3018288.
.03800	4387.0	690.50	3029224.
.04000	4395.0	689.80	3031671.
.04200	4394.0	689.00	3027466.
.04400	4383.0	688.10	3015942.
.04600	4362.0	687.10	2997130.
.04800	4331.0	686.20	2971932.
.05000	4293.0	685.30	2941993.
.05500	4175.0	683.40	2853195.
.06000	4081.0	682.40	2784874.
.06500	4047.0	682.60	2762482.
.07000	4092.0	683.70	2797700.
.07500	4205.0	685.00	2880425.
.08000	4335.0	685.70	2986224.
.08500	4491.0	685.50	3078581.
.09000	4579.0	684.30	3133410.
.09500	4627.0	682.40	3157465.
.10000	4639.0	680.10	3154984.
.11000	4546.0	674.80	3067641.
.12000	4346.0	670.10	2912255.
.13000	4167.0	668.30	2784806.
.14000	4132.0	669.70	2767200.

(CONTINUED)

TABLE 6.2-21A (CONTD)

TIME (SECONDS)	FLOW.RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
.15000	4260.0	671.10	2858886.
.16000	4455.0	669.70	2983514.
.17000	4624.0	665.80	3078659.
.18000	4733.0	660.10	3124253.
.19000	4788.0	653.30	3128000.
.20000	4801.0	646.00	3101446.
.22000	4851.0	631.30	3062436.
.24000	4739.0	620.30	2939602.
.26000	4519.0	619.00	2797261.
.28000	4566.0	622.40	2841878.
.30000	4920.0	624.30	3071556.
.32000	5377.0	622.80	3348796.
.34000	5704.0	620.80	3539902.
.36000	5846.0	620.30	3626274.
.38000	5907.0	618.40	3652889.
.40000	5851.0	616.20	3605386.
.42000	5840.0	615.90	3596856.
.44000	5858.0	614.50	3599741.
.46000	5871.0	612.90	3598836.
.48000	5866.0	612.20	3591165.
.50000	5815.0	610.50	3550058.
.55000	5807.0	608.40	3532979.
.60000	5786.0	606.60	3509788.
.65000	5615.0	605.20	3398198.
.70000	5382.0	604.10	3251266.
.75000	5090.0	602.50	3066725.
.80000	4390.0	602.60	2645414.
.85000	4906.0	599.70	2942128.
.90000	4920.0	597.50	2939700.
.95000	3632.0	590.10	2143243.
1.00000	4519.0	595.60	2691516.
1.10000	4565.0	595.40	2718001.
1.20000	4679.0	595.80	2787748.
1.30000	3553.0	598.10	2125049.
1.40000	4715.0	595.60	2808254.
1.50000	4339.0	595.60	2584308.
1.60000	4321.0	595.90	2574884.
1.70000	3941.0	596.60	2351201.
1.80000	3956.0	595.20	2354611.
1.90000	3973.0	595.30	2365127.
2.00000	3233.0	612.70	1980859.
2.50000	2953.0	588.90	1739022.
3.00000	3397.0	618.20	2100025.
3.50000	3134.0	593.70	1860656.
4.00000	3460.0	605.00	2093300.

TABLE 6.2-21B

MASS/ENERGY RELEASE RATES FOR 161 SQ IN
SURGE LINE GUIL BREAK AT PRESS. NOZZLE
FOR CONTAINMENT SUBCOMPARTMENT ANALYSIS
(FLOW FROM PRESSURIZER SIDE)
Cycle 1

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
0.00000	0.0	700.70	0.
.00100	7250.0	700.70	5080075.
.00200	7249.0	700.70	5079374.
.00300	7249.0	700.70	5079374.
.00400	7248.0	700.70	5078674.
.00500	7247.0	700.70	5077973.
.00600	7247.0	700.70	5077973.
.00700	7246.0	700.70	5077272.
.00800	7246.0	700.70	5077272.
.00900	7245.0	700.70	5076572.
.01000	7244.0	700.70	5075871.
.01200	7243.0	700.70	5075170.
.01400	7242.0	700.70	5074469.
.01600	7242.0	700.60	5072344.
.01800	7239.0	700.60	5071643.
.02000	7238.0	700.60	5070943.
.02200	7236.0	700.60	5069542.
.02400	7235.0	700.60	5068841.
.02600	7234.0	700.60	5068140.
.02800	7233.0	700.60	5067440.
.03000	7231.0	700.60	5066039.
.03200	7230.0	700.60	5065338.
.03400	7229.0	700.60	5064637.
.03600	7227.0	700.60	5063236.
.03800	7226.0	700.60	5062536.
.04000	7225.0	700.60	5061835.
.04200	7224.0	700.60	5061134.
.04400	7222.0	700.60	5059733.
.04600	7221.0	700.50	5058311.
.04800	7220.0	700.50	5057610.
.05000	7218.0	700.50	5056209.
.05500	7215.0	700.50	5054108.
.06000	7212.0	700.50	5052006.
.06500	7209.0	700.50	5049905.
.07000	7205.0	700.50	5047103.
.07500	7202.0	700.50	5045001.
.08000	7198.0	700.40	5041479.
.08500	7193.0	700.40	5037977.
.09000	7189.0	700.40	5035176.
.09500	7184.0	700.40	5031674.
.10000	7179.0	700.40	5028172.
.11000	7169.0	700.30	5020451.
.12000	7164.0	700.30	5014148.
.13000	7150.0	700.30	5007145.
.14000	7141.0	700.20	5000128.

(CONTINUED)

TABLE 6.2-21B (CONT.)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHLAPY (BTU/LB)	ENERGY RATE (BTU/SEC)
.15000	7131.0	700.20	4993126.
.16000	7122.0	700.20	4986824.
.17000	7112.0	700.10	4979111.
.18000	7103.0	700.10	4972810.
.19000	7093.0	700.10	4965809.
.20000	7084.0	700.00	4958800.
.22000	7064.0	700.00	4944800.
.24000	7045.0	699.90	4930796.
.26000	7026.0	699.80	4916795.
.28000	7007.0	699.80	4903499.
.30000	6989.0	699.70	4890203.
.32000	6970.0	699.60	4876212.
.34000	6950.0	699.50	4861525.
.36000	6929.0	699.50	4846836.
.38000	6909.0	699.40	4832155.
.40000	6889.0	699.30	4817478.
.42000	6870.0	699.30	4804191.
.44000	6850.0	699.20	4789520.
.46000	6831.0	699.10	4775552.
.48000	6811.0	699.00	4760889.
.50000	6792.0	699.00	4747608.
.55000	6740.0	698.80	4709912.
.60000	6693.0	698.60	4675730.
.65000	6645.0	698.40	4640868.
.70000	6599.0	698.20	4607422.
.75000	6552.0	698.10	4573951.
.80000	6506.0	697.90	4540537.
.85000	6461.0	697.70	4507840.
.90000	6416.0	697.50	4475160.
.95000	6371.0	697.30	4442498.
1.00000	6326.0	697.10	4409855.
1.10000	6238.0	696.70	4346015.
1.20000	6151.0	696.30	4282941.
1.30000	6065.0	695.80	4220027.
1.40000	5980.0	695.40	4158492.
1.50000	5896.0	695.00	4097720.
1.60000	5813.0	694.50	4037129.
1.70000	5724.0	694.10	3973028.
1.80000	5663.0	693.60	3927857.
1.90000	5609.0	693.10	3887598.
2.00000	5559.0	692.60	3850163.
2.50000	5338.0	689.90	3682686.
3.00000	5123.0	686.70	3517964.
3.50000	4903.0	682.90	3348259.
4.00000	4705.0	678.10	3190461.

TABLE 6.2-22

MASS/ENERGY RELEASE RATE FOR 9.284 SQ IN
PRESSURIZER RELIEF NOZZLE GUILL BREAK
FOR CONTAINMENT SUBCOMPARTMENT ANALYSIS
(FLOW FROM PRESSURIZER SIDE)

Cycle 1

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
0.00000	0.0	751.0	0.
.00100	675.3	751.0	507150.
.00200	675.3	751.0	507150.
.00300	675.3	751.0	507150.
.00400	675.3	751.0	507150.
.00500	675.3	751.0	507150.
.00600	675.3	751.0	507150.
.00700	675.2	751.0	507075.
.00800	675.2	751.0	507075.
.00900	675.2	751.0	507075.
.01000	675.2	751.0	507075.
.01200	675.2	751.0	507075.
.01400	675.2	751.0	507075.
.01600	675.2	751.0	507075.
.01800	675.1	751.0	507000.
.02000	675.1	751.0	507000.
.02200	675.1	751.0	507000.
.02400	675.1	751.0	507000.
.02600	675.1	751.0	507000.
.02800	675.0	751.0	506925.
.03000	675.0	751.0	506925.
.03200	675.0	751.0	506925.
.03400	675.0	751.0	506925.
.03600	675.0	751.0	506925.
.03800	674.9	751.0	506850.
.04000	674.9	751.0	506850.
.04200	674.9	751.0	506850.
.04400	674.9	751.0	506850.
.04600	674.9	751.0	506850.
.04800	674.9	751.0	506850.
.05000	674.8	751.0	506775.
.05500	674.8	751.0	506775.
.06000	674.7	751.0	506700.
.06500	674.7	751.0	506700.
.07000	674.6	751.0	506625.
.07500	674.6	751.0	506625.
.08000	674.5	751.0	506650.
.08500	674.5	751.0	506650.
.09000	674.4	751.0	506474.
.09500	674.4	751.0	506474.
.10000	674.4	751.0	506474.
.11000	674.3	751.0	506399.
.12000	674.2	751.0	506324.
.13000	674.1	751.0	506249.
.14000	674.0	751.0	506174.

(CONTINUED)

TABLE 6.2-22 (CONT.)

TIME (SECONDS)	FLOW.RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
.15000	673.9	751.00	506099.
.16000	673.8	751.00	506024.
.17000	673.7	751.00	505949.
.18000	673.6	751.00	505874.
.19000	673.5	751.00	505799.
.20000	673.4	750.90	505656.
.22000	673.2	750.90	505506.
.24000	673.0	750.90	505356.
.26000	672.8	750.90	505206.
.28000	672.7	750.90	505130.
.30000	672.5	750.90	504980.
.32000	672.3	750.90	504830.
.34000	672.1	750.90	504680.
.36000	671.9	750.90	504530.
.38000	671.7	750.90	504380.
.40000	671.5	750.90	504229.
.42000	671.4	750.90	504154.
.44000	671.2	750.90	504004.
.46000	671.0	750.90	503854.
.48000	670.8	750.90	503704.
.50000	670.6	750.90	503554.
.55000	670.1	750.90	503178.
.60000	669.7	750.80	502811.
.65000	669.2	750.80	502435.
.70000	668.8	750.80	502135.
.75000	668.3	750.80	501760.
.80000	667.9	750.80	501459.
.85000	667.4	750.70	501017.
.90000	667.0	750.70	500717.
.95000	666.5	750.70	500342.
1.00000	666.1	750.70	500041.
1.10000	665.2	750.60	499299.
1.20000	664.3	750.60	498624.
1.30000	663.4	750.60	497948.
1.40000	662.5	750.50	497206.
1.50000	661.6	750.50	496531.
1.60000	660.7	750.50	495855.
1.70000	659.8	750.40	495114.
1.80000	658.9	750.40	494439.
1.90000	658.1	750.40	493838.
2.00000	657.3	750.30	493172.
2.50000	653.8	749.80	490219.
3.00000	651.9	748.80	488143.
3.50000	651.1	747.60	486762.
4.00000	650.6	746.60	485608.

TABLE 6.2-23A

MASS/ENERGY RELEASE RATES FOR SPRAY LINE
GUILLOTINE BREAK AT PRESSURIZER NOZZLE
FOR CONTAINMENT SUBCOMPARTMENT ANALYSIS
11.871 SQ. IN BRAKE AREA
(FLOW FROM PRESSURIZER SIDE)

Cycle 1

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
0.00000	0.0	751.00	0.
.00100	188.2	751.00	141338.
.00200	188.2	751.00	141338.
.00300	188.2	751.00	141338.
.00400	188.2	751.00	141338.
.00500	188.2	751.00	141338.
.00600	188.2	751.00	141338.
.00700	188.2	751.00	141338.
.00800	188.2	751.00	141338.
.00900	188.2	751.00	141338.
.01000	188.2	751.00	141338.
.01200	188.2	751.00	141338.
.01400	188.2	751.00	141338.
.01600	188.2	751.00	141338.
.01800	188.2	751.00	141338.
.02000	188.2	751.00	141338.
.02200	188.2	751.00	141338.
.02400	188.2	751.00	141338.
.02600	188.2	751.00	141338.
.02800	188.2	751.00	141338.
.03000	188.2	751.00	141338.
.03200	188.2	751.00	141338.
.03400	188.2	751.00	141338.
.03600	188.2	751.00	141338.
.03800	188.2	751.00	141338.
.04000	188.2	751.00	141338.
.04200	188.2	751.00	141338.
.04400	188.2	751.00	141338.
.04600	188.2	751.00	141338.
.04800	188.2	751.00	141338.
.05000	188.2	751.00	141338.
.05500	188.2	751.00	141338.
.06000	188.2	751.00	141338.
.06500	188.2	751.00	141338.
.07000	188.2	751.00	141338.
.07500	188.2	751.00	141338.
.08000	188.2	751.00	141338.
.08500	188.2	751.00	141338.
.09000	188.2	751.00	141338.
.09500	188.2	751.00	141338.
.10000	188.2	751.00	141338.
.11000	188.1	751.00	141263.
.12000	188.1	751.00	141263.
.13000	188.1	751.00	141263.
.14000	188.1	751.00	141263.

(CONTINUED)

TABLE 6.2-23A (CONT.)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
.15000	188.1	751.00	141263.
.16000	188.1	751.00	141263.
.17000	188.1	751.00	141263.
.18000	188.1	751.00	141263.
.19000	188.1	751.00	141263.
.20000	188.0	751.00	141188.
.22000	188.0	751.00	141188.
.24000	188.0	751.00	141188.
.26000	188.0	751.00	141188.
.28000	187.9	751.00	141113.
.30000	187.9	751.00	141113.
.32000	187.8	751.00	141038.
.34000	187.8	751.00	141038.
.36000	187.7	751.00	140963.
.38000	187.7	751.00	140963.
.40000	187.6	750.90	140869.
.42000	187.6	750.90	140869.
.44000	187.5	750.90	140794.
.46000	187.4	750.90	140719.
.48000	187.4	750.90	140719.
.50000	187.3	750.90	140644.
.55000	187.0	750.90	140418.
.60000	186.8	750.90	140268.
.65000	186.5	750.90	140043.
.70000	186.2	750.90	139818.
.75000	185.9	750.80	139574.
.80000	185.5	750.80	139273.
.85000	185.2	750.80	139048.
.90000	184.8	750.80	138748.
.95000	184.4	750.70	138429.
1.00000	184.0	750.70	138129.
1.10000	183.2	750.60	137510.
1.20000	182.3	750.60	136834.
1.30000	181.5	750.50	136216.
1.40000	180.8	750.50	135690.
1.50000	180.2	750.40	135222.
1.60000	179.7	750.40	134847.
1.70000	179.3	750.40	134547.
1.80000	178.9	750.30	134229.
1.90000	178.7	750.30	134079.
2.00000	178.6	750.30	134004.
2.50000	178.2	750.30	133703.
3.00000	176.7	750.10	132543.
3.50000	174.2	750.00	130650.
4.00000	172.9	749.90	129658.

TABLE 6.2-23B

MASS/ENERGY RELEASE RATES FOR SPRAY LINE
GUILLOTINE BREAK AT PRESSURIZER NOZZLE
FOR CONTAINMENT SUBCOMPARTMENT ANALYSIS
11.871 SQ IN BREAK AREA
(FLOW FROM COLD LEG SIDE)

Cycle 1

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
0.00000	0.0	544.70	0.
.00100	1546.0	544.60	841952.
.00200	1530.0	544.50	833085.
.00300	1516.0	544.50	825462.
.00400	1505.0	544.40	819322.
.00500	1495.0	544.30	813729.
.00600	1486.0	544.20	808681.
.00700	1480.0	544.20	805416.
.00800	1477.0	544.20	803783.
.00900	1476.0	544.20	803239.
.01000	1477.0	544.20	803783.
.01200	1486.0	544.30	808830.
.01400	1503.0	544.40	818233.
.01600	1522.0	544.50	828729.
.01800	1542.0	544.60	839773.
.02000	1561.0	544.70	850277.
.02200	1575.0	544.80	858060.
.02400	1583.0	544.90	862577.
.02600	1584.0	544.90	863122.
.02800	1580.0	544.80	860784.
.03000	1572.0	544.80	856426.
.03200	1563.0	544.70	851366.
.03400	1554.0	544.70	846464.
.03600	1548.0	544.70	843196.
.03800	1544.0	544.60	840862.
.04000	1542.0	544.60	839773.
.04200	1541.0	544.60	839229.
.04400	1540.0	544.60	838684.
.04600	1539.0	544.60	838139.
.04800	1536.0	544.60	836506.
.05000	1533.0	544.60	834872.
.05500	1523.0	544.50	829274.
.06000	1522.0	544.50	828729.
.06500	1538.0	544.60	837595.
.07000	1558.0	544.70	848643.
.07500	1561.0	544.70	850277.
.08000	1540.0	544.60	838684.
.08500	1514.0	544.40	824222.
.09000	1504.0	544.40	818778.
.09500	1517.0	544.50	826007.
.10000	1539.0	544.60	838139.
.11000	1545.0	544.60	841407.
.12000	1522.0	544.50	828729.
.13000	1518.0	544.50	826551.
.14000	1505.0	544.40	819322.

(CONTINUED)

TABLE 6.2-23B(CONT.)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)
.15000	1522.0	544.50	828729.
.16000	1539.0	544.60	838139.
.17000	1507.0	544.40	820411.
.18000	1499.0	544.30	815906.
.19000	1522.0	544.50	828729.
.20000	1523.0	544.50	829274.
.22000	1495.0	544.30	813729.
.24000	1524.0	544.50	829818.
.26000	1483.0	544.30	807197.
.28000	1514.0	544.50	824373.
.30000	1490.0	544.30	811007.
.32000	1508.0	544.40	820955.
.34000	1484.0	544.30	807741.
.36000	1506.0	544.40	819866.
.38000	1484.0	544.30	807741.
.40000	1501.0	544.40	817144.
.42000	1496.0	544.40	811156.
.44000	1496.0	544.40	814422.
.46000	1493.0	544.40	812789.
.48000	1497.0	544.40	814967.
.50000	1490.0	544.40	811156.
.55000	1494.0	544.50	813483.
.60000	1504.0	544.60	819078.
.65000	1510.0	544.60	822346.
.70000	1513.0	544.70	824131.
.75000	1520.0	544.80	828096.
.80000	1527.0	544.90	832062.
.85000	1535.0	545.00	836575.
.90000	1542.0	545.10	840544.
.95000	1548.0	545.20	843970.
1.00000	1554.0	545.30	847396.
1.10000	1563.0	545.50	852617.
1.20000	1566.0	545.70	854566.
1.30000	1562.0	545.80	852540.
1.40000	1554.0	546.00	848484.
1.50000	1542.0	546.10	842086.
1.60000	1528.0	546.20	834594.
1.70000	1513.0	546.20	826401.
1.80000	1500.0	546.30	819450.
1.90000	1489.0	546.50	813739.
2.00000	1481.0	546.60	809515.
2.50000	1493.0	547.60	817567.
3.00000	1508.0	548.70	827440.
3.50000	1470.0	549.30	807471.
4.00000	1455.0	550.20	800541.

TABLE 6.2-24

FULL DE GUILLOTINE MAIN STEAM LINE BREAK

(PT.16) FOR CONTAINMENT SUBCOMPARTMENT ANALYSIS
Cycle 1

FLOW FROM SG SIDE			FLOW FROM TURBINE SIDE		
Time (Sec)	Mass Flowrate (lbm/sec)	Enthalpy (Btu/lbm)	Time (sec)	Mass Flowrate (lbm/sec)	Enthalpy (Btu/Lbm)
0.0	0.0	1.19933×10^3	0.0	0.0	1.19939×10^3
.0011	8.05056×10^3	1.19111×10^3	.00110	7.07809×10^3	1.17993×10^3
.0025	6.04424×10^3	1.16928×10^3	.00270	3.62910×10^3	1.11925×10^3
.0038	5.6487×10^3	1.17067×10^3	.00470	1.45258×10^3	1.04429×10^3
.0060	5.74435×10^3	1.17226×10^3	.00600	0.818096×10^3	1.00633×10^3
.0080	5.46778×10^3	1.17143×10^3	.00740	0.64944×10^3	1.03556×10^3
.0100	5.54377×10^3	1.17953×10^3	.01000	1.08101×10^3	1.17254×10^3
.0122	5.82598×10^3	1.17752×10^3	.01900	3.73205×10^3	1.21186×10^3
.0140	5.55595×10^3	1.16532×10^3	.02700	5.34259×10^3	1.19658×10^3
.0170	4.69763×10^3	1.15526×10^3	.03300	5.99437×10^3	1.1868×10^3
.0181	4.60677×10^3	1.16087×10^3	.04300	6.30914×10^3	1.17335×10^3
.0200	4.78633×10^3	1.17681×10^3	.05300	6.13839×10^3	1.16209×10^3
.0240	5.48536×10^3	1.19944×10^3	.06000	5.98923×10^3	1.1558×10^3
.0260	5.82745×10^3	1.20299×10^3	.1000	4.46640×10^3	1.13503×10^3
.0280	6.08692×10^3	1.20101×10^3	.1250	3.93183×10^3	1.13242×10^3
.0301	6.17320×10^3	1.19509×10^3	.1540	3.6913×10^3	1.14996×10^3
.0430	5.69838×10^3	1.16705×10^3	.1800	3.86306×10^3	1.17082×10^3
.0500	5.21566×10^3	1.15847×10^3	.2150	4.27972×10^3	1.17981×10^3
.06200	4.90710×10^3	1.16638×10^3	.2500	4.43253×10^3	1.17696×10^3
.09150	5.42350×10^3	1.18471×10^3	.2750	4.39358×10^3	1.17435×10^3
.11950	5.04370×10^3	1.17606×10^3	.3860	4.15551×10^3	1.17436×10^3
.14000	5.20843×10^3	1.18766×10^3	.410	4.18010×10^3	1.17886×10^3
.1550	5.45279×10^3	1.20054×10^3	.490	4.46476×10^3	1.19291×10^3
.1800	6.10725×10^3	1.21321×10^3	.565	4.73559×10^3	1.19987×10^3
.20600	6.31569×10^3	1.21054×10^3	.625	4.87102×10^3	1.20151×10^3
.2400	6.21232×10^3	1.20318×10^3	.725	4.9739×10^3	1.2012×10^3
.2850	6.18929×10^3	1.20065×10^3	1.00	4.96876×10^3	1.19962×10^3
.340	6.13367×10^3	1.19839×10^3			
.400	6.11393×10^3	1.19835×10^3			
1.000	6.09481×10^3	1.19815×10^3			

6.2-25 TABLE

RESULTS OF SUBCOMPARTMENT ANALYSIS

Cycle 1

	Peak Node Pressure (psia)	Reference Figure*	Peak Wall Differential Pressure (psi)	Reference Figure*
REACTOR CAVITY (1)				
1 Hot leg guillotine Break at R.V. Nozzle	19.1	--	30.5	-
2 Discharge Leg Guillotine Break at R.V. Nozzle	100.1	6.2-25B	86.	6.2-251
STEAM GENERATOR				
3 Hot Leg Guillotine Freak at S.G. Nozzle (2)	20.2	-	5.6	-
4 Suction Leg Guillotine Break at S.G. Nozzle (2)	20.6	6.2-28A	5.9	6.2-28n
5 Suction Leg Guillotine Break at Pump Nozzle (2)	20.0	-	5.3	-
6 & 6a Suction Leg slot break at Pump Elbow & st S G Elbow (2)	18.0	-	3.2	-
7 Discharge Leg Guillotine Break at Pump Nozzle (2)	20.0	-	5.3	-
8 Main Steam Line Double Ended Guillotine Break at Point 16 (5)	17.3	-	2.4	-
PRESSURIZER AREA				
9 Pressurizer surge line guillotine Break at Pressurizer Nozzle (4)	37.4 (EL 29.5') 16.0 (EL 62')	 -	22.7 (6) 1.3	6.2-30e 6.2-30f
10 Pressurizer Safety Relief Line Guillotine Break at Pressurizer Nozzle (3)	14.8 (EL 62')	-	0.041	-
11 Pressurizer Spray line Guillotine Break at Pressurizer Nozzle (4)	14.9 (EL 62')	-	0.064	-

* Only worst cases presented

Note: Subcompartment walls are designed to withstand the maximum pressure differential resulting from the design basis subcompartment break.

(1) Analysis is no longer required due to application of the LBB criteria (refer to UFSAR 6.2.1.2.3)
(2) This break is eliminated due to the application of LBB criteria (refer to UFSAR 6.2.1.2.3)
(3) The pre-EPU M&E release data remains unchanged at EPU conditions (refer to UFSAR 6.2.1.2.3)
(4) The pre-EPU M&E release data slightly increases at EPU conditions (refer to UFSAR 6.2.1.2.3)
(5) The pre-EPU M&E release data for this break is not the limiting case
(6) 22.5 x 1.008 = 22.7 (based on Figure 6.2-30e)

TABLE 6.2-26
(Historical)
REACTOR CAVITY SUBCOMPARTMENT ANALYSIS
VENT PATH DESCRIPTION

Junction Number	From Vol. (defines Forward)	To Vol	Area (ft^2)	Elevation (ft)	Inertia Coefficient (L/A) (ft^{-1})	Total Head Forward	Loss Coefficient Reverse	Comments
1	1	7	34.36	25.5	0.1343	0.2229	0.2113	From Cavity to Pipe Penetrations
2	2	8	16.726	“	0.4365	0.9132	1.0801	
3	3	9	16.726	“	0.3363	0.8955	1.0624	
4	4	10	34.36	“	0.1343	0.2229	0.2113	
5	5	11	16.726	“	0.3114	0.8892	1.0560	
6	6	12	16.726	“	0.2362	0.8689	1.0360	
7	7	32	31.3	“	0.1243	1.0065	0.54	From Pipe Penetrations to Sec. Shld. Wall Area
8	8	32	16.726	“	0.4265	1.0756	0.60	
9	9	33	66.4	“	0.0916	0.9455	0.55	
10	10	33	31.3	“	0.1243	1.0065	0.54	
11	11	33	16.726	“	0.3014	1.074	0.60	
12	12	32	16.726	25.5	0.2262	1.0539	0.58	
13	1	41	24.94	36.0	0.2510	0.582	0.361	Vent Path to Upper Cavity
14	2	41	24.94	“	“	“	“	
15	3	41	24.94	“	“	“	“	
16	4	41	24.94	“	“	“	“	
17	5	41	24.94	“	“	“	“	
18	6	41	24.94	36.0	0.2510	0.582	0.361	
19	1	13	13.33	24.5	0.72220	0.308	0.300	
20	2	14	5.7	“	1.556	0.516	0.490	
21	2	15	5.7	“	1.556	0.516	0.490	
22	3	16	16.2	“	0.6460	0.213	0.248	
23	4	17	2.834	“	2.664	1.027	0.801	
24	4	18	2.834	“	2.664	1.027	0.801	
25	5	19	16.2	“	0.6460	1.213	0.248	
26	6	20	5.7	“	1.556	0.516	0.490	
27	6	21	5.7	24.5	1.556	0.516	0.490	
28	1	2	16.39	24.5	0.574	0.455	0.494	
29	2	3	14.01	“	0.543	0.371	0.439	
30	3	4	11.14	“	0.606	0.571	0.436	
31	5	4	11.14	“	0.606	0.571	0.436	
32	6	5	14.01	“	0.543	0.371	0.439	
33	1	6	16.39	24.5	0.574	0.455	0.494	
34	13	14	35.31	10.0	0.2176	0.035	0.035	
35	14	15	11.14	“	0.23	0.843	0.843	
36	15	16	35.31	“	0.2176	0.051	0.051	
37	16	17	35.31	“	0.2176	0.051	0.051	
38	18	17	11.14	“	0.23	0.843	0.843	
39	19	18	35.31	“	0.2176	0.051	0.051	
40	20	19	35.31	“	0.2176	0.051	0.051	
41	21	20	11.14	“	0.23	0.843	0.843	
42	13	21	35.31	“	0.2176	0.051	0.051	
43	13	22	24.94	“	0.4624	0.152	0.137	
44	14	23	11.417	“	1.01	0.223	0.207	
45	15	24	11.417	“	1.01	0.223	0.207	

TABLE 6.2-26 (Cont'd)
(Historical)

Junction Number		From Vol. To Vol. (defines Forward)	Area (ft^2)	Elevation (ft)	Inertia Coefficient (L/A) (ft^{-1})	Total Head Loss Coefficient Forward	Reverse	COMMENTS
46	16	25	24.94	10.0	0.4624	0.152	0.137	
47	17	26	11.417	"	1.01	0.223	0.207	
48	18	27	11.417	"	1.01	0.223	0.207	
49	19	28	24.94	"	0.4624	0.152	0.137	
50	20	29	11.417	"	1.01	0.223	0.207	
51	21	30	11.417	10.0	1.01	0.223	0.207	
52	22	23	36.6	1.4349	0.210	0.0841	0.0841	
53	23	24	22.32	"	0.229	0.373	0.373	
54	24	25	36.6	"	0.210	0.0841	0.0341	
55	25	26	36.6	"	0.210	0.0841	0.0841	
56	26	27	22.32	"	0.229	0.373	0.373	
57	28	27	36.6	"	0.210	0.0841	0.0841	
58	29	28	36.6	"	0.210	0.0841	0.0841	
59	30	29	22.32	"	0.229	0.373	0.373	
60	22	30	36.6	"	0.210	0.0841	0.0841	
61	22	31	63.36	"	0.1034	0.777	0.411	
62	23	31	30.7	"	0.20	0.8938	0.44	
63	24	31	30.7	"	0.20	0.8938	0.44	
64	25	31	63.36	"	0.1034	0.777	0.411	
65	26	31	30.7	"	0.20	0.8938	0.44	
66	27	31	30.7	"	0.20	0.8938	0.44	
67	28	31	63.36	"	0.1034	0.777	0.411	
68	29	31	30.7	"	0.20	0.8938	0.44	
69	30	31	30.7	1.4349	0.20	0.8938	0.44	
70	31	40	16.3216	-2.92	0.258	0.8357	1.006	
71	40	32	49.0	18.0	0.1935	1.013	0.4968	
72	22	34	43.125	1.4349	0.2255	0.335	0.307	
73	25	35	43.125	1.4349	0.2255	0.335	0.307	
74	34	36	20.21	0.0	0.2549	2.555	2.555	Relief Dampers
75	35	37	25.875	"	0.2549	2.554	2.554	
76	36	38	43.125	"	0.1343	0.271	0.271	
77	37	38	43.125	"	0.1343	0.271	0.271	
78	38	39	78.0	0.0	0.192	1.012	0.512	
79	39	43	78.0	7.5	0.1204	0.47	0.824	
80	41	42	144.0	62.0	0.0239	1.3812	1.1711	
81	33	42	218.0	62.0	0.0177	0.65	0.397	
82	32	42	218.0	62.0	0.0177	0.65	0.397	
83	43	32	78.0	18.0	0.1230	1.020	0.5313	

TABLE 6.2-27
(Historical)
REACTOR CAVITY SUBCOMPARTMENT ANALYSIS
NODE DESCRIPTION

Node Number	Volume (ft^3)	Height (ft)	Elevation (ft)
01	228.24	11.501	24.5
02	239.95	11.501	24.5
03	249.92	11.501	24.5
04	218.27	11.501	24.5
05	249.92	11.501	24.5
06	239.95	11.501	24.5
07	216.48	8.0	25.5
08	354.0	7.0	25.5
09	497.52	7.0	25.5
10	216.48	8.0	25.5
11	247.04	7.0	25.5
12	208.31	7.0	25.5
13	343.6	14.501	10.0
14	113.43	14.501	10.0
15	113.43	14.501	10.0
16	343.6	14.501	10.0
17	113.43	14.501	10.0
18	113.43	14.501	10.0
19	343.6	14.501	10.0
20	113.43	14.501	10.0
21	113.43	14.501	10.0
22	307.15	8.5652	1.4349
23	138.5	8.5652	1.4349
24	138.5	8.5652	1.4349
25	307.15	8.5652	1.4349
26	138.5	8.5652	1.4349
27	138.5	8.5652	1.4349
28	307.15	8.5652	1.4349
29	138.5	8.5652	1.4349
30	138.5	8.5652	1.4349
31	1483.65	4.3550	-2.92
32	73316.0	44.0	18.0
33	73316.0	44.0	18.0
34	582.0	7.50	0.0
35	453.0	7.50	0.0
36	336.0	7.50	0.0
37	455.0	7.50	0.0
38	396.0	7.50	0.0
39	5558.0	7.501	0.0
40	1556.1	25.001	-7.0
41	155102+5	32.5	36.0
42	1.485+6	157.0	62.0
43	1638.0	10.5	7.5

TABLE 6.2-28
SECONDARY SHIELD WALL SUBCOMPARTMENT ANALYSIS
VENT PATH DESCRIPTIONS

Cycle 1

JUN NUM	FROM VOL	TO VOL	JUNCTION FLOW AREA (FT**2)	JUNCTION ELEVATION (FT)	JUNCTION INERTIA (L/A) (FT-1)	TOTAL HEAD LOSS COEF. (FORWARD)	LOSS COEF. (REVERSE)
1	1	2	.448140E+03	.180000E+02	.442530E-01	.627090E-01	.508850E-01
2	1	3	.280620E+03	.360000E+02	.750440E-01	.124250E+00	.104955E+00
3	2	4	.174686E+04	.360000E+02	.127500E-01	.765180E-01	.593040E-01
4	3	4	.309860E+03	.360000E+02	.502280E-01	.326620E+00	.317262E+00
5	3	5	.111130E+03	.580000E+02	.637770E-01	.439480E+00	.598859E+00
6	4	6	.174900E+03	.580000E+02	.284880E-01	.461340E+00	.804227E+00
7	5	6	.361600E+02	.580000E+02	.247617E+00	.256280E+00	.248869E+00
8	5	7	.143270E+03	.620000E+02	.687300E-01	.942980E-01	.857130E-01
9	6	8	.147410E+03	.620000E+02	.6796B0E-01	.114250E+00	.736980E-01
10	7	8	.400500E+02	.620000E+02	.140000E+00	.961640E+00	.947378E+00
11	7	19	.105190E+03	.760000E+02	.692870E-01	.117450E+01	.630984E+00
12	8	19	.113500E+03	.760000E+02	.678950E-01	.114800E+01	.596697E+00
13	1	9	.208250E+03	.180000E+02	.475000E-01	.107230E+01	.770253E+00
14	2	9	.148650E+03	.180000E+02	.572590E-01	.119450E+01	.947378E+00
15	2	10	.176180E+03	.180000E+02	.444800E-01	.113580E+01	.858540E+00
16	3	9	.189700E+03	.360000E+02	.493780E-01	.110990E+01	.820577E+00
17	4	9	.145720E+03	.360000E+02	.578000E-01	.120090E+01	.951836E+00
18	4	10	.193100E+03	.360000E+02	.434900E-01	.110460E+01	.811898E+00
19	4	5	.596200E+02	.580000E+02	.516450E-01	.889620E+00	.125658E+01
20	4	19	.989570E+03	.580000E+02	.176450E-01	.105880E+01	.685130E+00
21	6	8	.216400E+02	.620000E+02	.146150E+00	.120400E+01	.119557E+01
22	9	11	.221990E+03	.180000E+02	.438530E-01	.828510E+00	.104159E+01
23	9	12	.147410E+03	.180000E+02	.574850E-01	.102490E+01	.119320E+01
24	10	12	.260600E+02	.180000E+02	.109874E+00	.143040E+01	.145284E+01
25	9	13	.189700E+03	.360000E+02	.493780E-01	.823760E+00	.110674E+01
26	9	14	.144180E+03	.360000E+02	.580930E-01	.960900E+00	.119999E+01
27	10	14	.232170E+03	.360000E+02	.417420E-01	.714000E+00	.102173E+01
28	14	19	.994120E+03	.580000E+02	.176270E-01	.105680E+O1	.682620E+00
29	20	26	.250000E+02	.180000E+02	.330000E+00	.338281E+00	.338281E+00
30	23	26	.250000E+02	.180000E+02	.330000E+00	.338261E+00	.338281E+00
31	11	12	.544790E+03	.180000E+02	.366110E-01	.585970E-01	.585970E-01
32	11	13	.278620E+03	.360000E+02	.727910E-01	.162900E+00	.136563E+00
33	12	14	.106390E+04	.360000E+02	.142200E-01	.436090E+00	.424450E+00
34	13	14	.151910E+03	.360000E+02	.703610E-01	.839200E+00	.824091E+00
35	14	15	.596200E+02	.580000E+02	.516450E-01	.889620E+00	.125658E+01
36	13	15	.111130E+03	.580000E+02	.637770E-01	.439480E+00	.598859E+00
37	15	16	.361600E+02	.580000E+02	.247617E+00	.256280E+00	.248869E+00
38	16	18	.147220E+03	.620000E+02	.679850E-01	.115000E+00	.745320E-01

TABLE 6.2-28 (Cont'd)

JUN NUM	FROM VOL	TO VOL	JUNCTION FLOW AREA (FT**2)	JUNCTION ELEVATION (FT)	JUNCTION DIAMETER (FT)	JUNCTION INERTIA (L/A) (FT-1)	TOTAL HEAD LOSS COEF. (FORWARD)	LOSS COEF. (REVERSE)
39	15	17	.143270E+03	.620000E+02		.687300E-01	.942980E-01	.857130E-01
40	17	18	.400500E+02	.620000E+02		.140000E+00	.961640E+00	.947378E+00
41	18	19	.113500E+03	.760000E+02	.120213E+02	.678950E-01	.114800E+01	.596697E+00
42	17	19	.105190E+03	.760000E+02	.115729E+02	.692870E-01	.117450E+01	.630984E+00
43	9	10	.534470E+03	.480000E+02	.260866E+02	.342980E-01	.849210E+00	.846940E+00
44	2	20	.148000E+03	.180000E+02	.137273E+02	.700840E-01	.400100E+00	.400100E+00
45	12	23	.876000E+02	.180000E+02	.105611E+02	.859100E-01	.715530E+00	.715530E+00
46	20	21	.505080E+03	.230000E+02	.253592E+02	.199520E-01	.150450E+01	.150450E+01
47	21	22	.124300E+04	.450000E+02	.397824E+02	.106910E-01	.169150E+01	.168904E+01
48	23	24	.441050E+03	.230000E+02	.236973E+02	.219830E-01	.156200E+01	.156200E+01
49	24	25	.135130E+04	.450000E+02	.414793E+02	.103520E-01	.164460E+01	.164209E+01
50	10	26	.187400E+03	.180000E+02	.154468E+02	.646070E-01	.456530E+00	.456530E+00
51	26	27	.449360E+03	.230000E+02	.239195E+02	.231700E-01	.146200E+01	.146200E+01
52	27	28	.894700E+03	.450000E+02	.337516E+02	.137530E-01	.176290E+01	.175967E+01
53	28	19	.116930E+04	.620000E+02	.385850E+02	.162920E-01	.224030E+01	.183911E+01
54	25	19	.116730E+04	.620000E+02	.385519E+02	.151440E-01	.231970E+01	.196317E+01
55	22	19	.140630E+04	.620000E+02	.423150E+02	.146530E-01	.221560E+01	.185021E+01
56	4	22	.170000E+03	.542500E+02	.147123E+02	.369056E+00	.147940E+01	.155736E+01
57	10	28	.190000E+03	.542500E+02	.155536E+02	.358736E+00	.156910E+01	.190675E+01
58	14	25	.107500E+03	.542500E+02	.116993E+02	.427196E+00	.177640E+01	.185214E+01
59	21	27	.350400E+03	.230000E+02	.211221E+02	.401790E+00	.155380E+00	.751700E-01
60	27	24	.350400E+03	.230000E+02	.211221E+02	.401790E+00	.155380E+00	.751700E-01
61	22	28	.270400E+03	.450000E+02	.185549E+02	.519983E+00	.170410E+00	.808710E-01
62	28	25	.270400E+03	.450000E+02	.185549E+02	.519983E+00	.170410E+00	.808710E-01
63	4	6	.216400E+02	.580000E+02	.524909E+01	.387415E+00	.130840E+01	.142766E+01
64	14	16	.216400E+02	.580000E+02	.524909E+01	.387415E+00	.130840E+01	.142766E+01
65	16	15	.216400E+02	.620000E+02	.524909E+01	.239243E+00	.121590E+01	.119963E+01
66	14	16	.174900E+03	.580000E+02	.149228E+02	.291640E-01	.461340E+00	.804227E+00
67	29	30	.230400E+03	.295000E+02	.171276E+02	.122010E+00	.592357E+00	.432210E+00
68	30	12	.166720E+03	.295000E+02	.145696E+02	.644460E-01	.435452E+00	.332340E+00
69	30	31	.150000E+02	.399200E+02	.437019E+01	.359280E+00	.833508E+00	.817140E+00
70	31	32	.253000E+02	.580000E+02	.567565E+01	.259988E+00	.262170E+00	.261890E+00
71	32	33	.253000E+02	.620000E+02	.567565E+01	.114644E+00	.666609E+00	.414870E+00
72	33	34	.131200E+03	.715000E+02	.129247E+02	.712700E-01	.105755E+00	.163330E+00
73	33	19	.280000E+02	.620000E+02	.597082E+01	.563058E+00	.111976E+01	.568280E+00
74	31	14	.130000E+03	.489200E+02	.128655E+02	.105777E+00	.476882E+00	.487610E+00
75	35	29	.579600E+02	.399200E+02	.859052E+01	.201316E+00	.217310E-01	.600120E-01

TABLE 6.2-29

SECONDARY SHIELD WALL SUBCOMPARTMENT ANALYSIS
NODE DESCRIPTION

VOL NUM	VOLUME (FT**3)	HEIGHT (FT)	ELEVATION (FT)	
1	.365390E+04.	.180010E+02	.180010E+02	NORTH STEAM GENERATOR AREA
2	.297148E+05	.180010E+02	.180010E+02	
3	.427430E+04	.220010E+02	.360000E+02	
4	.344284E+05	.220010E+02	.360000E+02	
5	.615400E+03	360000E+02	.580000E+02	
6	.631900E+03	.360000E+02	.580000E+02	
7	.157420E+04	.140010E+02	.620000E+02	
8	.165110E+04	.140010E+02	.620000E+02	
9	.288513E+05	.400000E+02	.180000E+02	
10	.307145E+05	.400000E+02	.180000E+02	
11	.330950E+04	.180010E+02	.180000E+02	SOUTH STEAM GENERATOR AREA
12	.171973E+05	.180010E+02	.180000E+02	
13	.426190E+04	.220010E+02	.360000E+02	
14	.196305E+05	.220010E+02	.360000E+02	
15	.615400E+03	.400100E+01	.580000e+02	
16	.631900E+03	.400100E+01	.580000e+02	
17	.157420E+02	.140010E+02	.620000E+02	
18	.165110E+02	.140010E+02	.620000E+02	
19	.144000E+07	.157000E+03	.580000E+02----------	UPPER CONTAINMENT
20	.820360E+04	.110010E+02	.120000E+02	
21	.435412E+05	.220010E+02	.230000E+02	VOLUMES OUTSIDE SECONDARY SHIELD WALL
22	.343250E+05	.170010E+02	.450000e+02	
23	.872530e+04	.110010e+02	.120000E+02	
24	.465777E+05	.220010E+02	.230000E+02	
25	.338135E+05	.170010E+02	.450000E+02	
26	.905170E+04	.110010E+02	.120000E+02	
27	.364271E+05	.220010E+02	.230000E+02	
28	.276762E+05	.170010E+02	.450000E+02	PRESSURIZER AREA VOLUMES
29	.635460E+03	.104210E+02	.295000E+02	
30	.635700E+03	.104210E+02	.295000E+02	
31	.899540E+03	.180810E+02	399200E+02	
32	.101960E+03	.400100E+01	.580000E+02	
33	.150750E+04	.950100E+02	.950100E+01	
34	.240690E+04	.135010E+02	.715000E+02	
35	.165489E+03	.500000E+01	.399200E+02	

TABLE 6.2-30

APPROXIMATE NSSS HEIGHTS AND FLOW AREAS

Location	Height (Ft)
Bottom of lower plenum	0.0
Bottom of annulus	3.139
Bottom of active core	9.663
Top of active core	21.055
Bottom of fuel alignment plate	22.271
Center of reactor vessel	27.040
Bottom of upper guide structure support plate	31.218
Top of Reactor Vessel upper head	40.005
Bottom of Suction Leg at steam generator	19.790
Bottom of steam generator plenum	27.398
Bottom of tube sheet	33.945
Top of tube sheet	35.822
Top of innermost tube bundle	58.081
Top of outermost tube bundle	64.733
Top of steam generator	86.354
Bottom of pressurizer	40.019
Top of pressurizer	69.878

AREAS

Location	Flow Area (Ft^2)
Pressurizer	51.05
Reactor vessel annulus	40.173
Active core	58.731
Hot Leg	9.62
SG active tubes	21.64
Cold leg	4.91

Table 6.2-31
This table has been deleted.

Table 6.2-32
This table has been deleted.

Table 6.2-33
This table has been deleted.

Table 6.2-34
This table has been deleted.

Table 6.2-35
This table has been deleted.

TABLE 6.2-36
VALVE CLOSURE TIMES AND ASSUMPTIONS USED IN MSLB ANALYSIS
EPU

Valve Closure Times (from receipt of signal)

1.	MSIV (I-HCV-08-1A and T-HCV-08-1B) closure time, sec	5.6
2.	MFIV (I-HCV-09-1A and I-HCV-09-2A) closure time, sec	4.0
3.	Backup feedwater isolation valve (I-HCV-09-1B,2B) closure time, sec	4.0
4.	Reactor trip on low steam generator pressure, psia	546
5.	Reactor trip on high containment pressure, psig	6.4
6.	Instrumentation delay time, sec	1.15

Assumptions

1. Credit is not taken for the coastdown of the main feedwater pumps or condensate pumps in the MSLB analysis. Therefore, no degradation of the feedwater flow occur until the closure of the main feedwater isolation or backup valves.

2. Offsite power is assumed to be available for the analysis. Availability of offsite power allows the continuation of reactor coolant pump and feedwater pump flows. Maintaining reactor coolant and feedwater pump flow maximizes the rate of primary to secondary heat transfer which maximizes the rate of mass/energy release.

Table 6.2-37
This table has been deleted.

TABLE 6.2-38

DESIGN DATA FOR CONTAINMENT SPRAY SYSTEM COMPONENTS

1. Containment Spray Pumps

Quantity	2
Type	Single stage vertical centrifugal
Number of Stages	1
Rotational speed, rpm	1780
Material	Casing - ASME SA182 F304 Impeller - ASTM A296 CA6NM Stainless steel for pressure parts in contact with borated water
Codes & Standards	Standards of the Hydraulic Institute, ASME Section III, 1974 Edition Winter Addenda Class 2
Liquid Pumped	Borated water (concentration of 1900 ppm boron buffered to a pH of 7.0 to 8.1)
Temperature	
Maximum, F	300
Minimum, F	40
Design Pressure, psig	300
Capacity each, gpm	2850*
Total Dynamic Head, ft	470
Connections	
Discharge, in.	8
Suction, in.	14

2. Motors

Quantity	One per pump
Type	Constant speed, 500 hp, 4000 volt, 60 Hz, 3-phase induction, 1.15 service factor
Insulation	Class F
Enclosure	WP II

* Includes 150 gpm for minimum recirculation flow to refueling water tank.

TABLE 6.2-38 (Cont'd)

2. Motors(Cont'd)

Shaft	Solid vertical
Code	NEMA

3. Piping, Fittings, and Valves

a. Suction Side

Material, Piping	Type 304 or 316 stainless steel
Pressure, psig	60
Temperature, F	300
Pipe Sizes	
2 in. and smaller	Schedule 40 S or higher wall thickness
2-1/2 in. through 12.in	Schedule 10 S or higher wall thickness
14 in. through 24 in.	0.250 in. nominal wall thickness
Connections	
2 in. and smaller	Socket weld
2-1/2 in. and larger	Butt weld
Code, Piping	ANSI B31.1, ASME III, Class 2 1971 Edition, Summer 1973 Addenda
Valves	
2 in. and smaller	Stainless steel, 600 lb rating
2-1/2 in. and larger	Stainless steel, 150 and 300 lb rating
Code, Valves	ANSI B16.5, ASME III, Class 2, 1974 Edition 1974 Edition (Summer 1975 Addenda) 1971 Edition (Winter 1973 Addenda)

b. Discharge Side

Material, piping	Type 304 or 316 stainless steel
Pressure, psig	300
Temperature, F	300
Pipe Sizes	
6 in. and smaller	Schedule 40 S or higher wall thickness
8 in. through 12 in.	0.250 in. nominal wall thickness

TABLE 6.2-38(Cont'd)

. b. Discharge Side (Cont'd)	
Connections	
2 in. and smaller	Socket weld
2-1/2 in. and larger	Butt weld
Code, Piping	Same as Suction Piping
3. Piping, Fittings, and Valves (Cont'd)	
Valves	
2 in. and smaller	Stainless steel 600 lb rating
2- ½ in. and larger	Stainless steel 150 to 300 lb rating
Code, valves	Same as Suction Piping
4. Spray Nozzles	Also refer to Table 6.2-43 Spray Nozzle Design Data
Quantity	178 per train (minimum)
Type	Open Throat
Material	Type 304 stainless steel
Flow per nozzle, gpm	15.2
Pressure drop, psi	40 when passing 15.2 gpm
Spray droplet size, microns	700 (3.93×10^{-5} in. mean value)
Orifice size, in.	0.375
5. Shutdown Heat Exchanger	Refer to Table 5.4-4 Shutdown Cooling Heat Exchanger Data

TABLE 6.2-38 (Cont'd)

DESIGN DATA AND MATERIALS FOR CONTAINMENT COOLING SYSTEM COMPONENTS (HVS-1A,1B,1C, & 1D)

1. Fans

Quantity	4
Type	Vaneaxial, airfoil blades (adjustable) direct motor driven

	Normal Conditions	Post-LOCA Conditions
Air flow each, cfm	60,000	39,600
Air mixture density, lb/ft^{3}pressure	0.075	0.187
Fan external static inches wg	4.0	3.7
Fan speed, rpm	1770	1170
Outlet velocity, FPM	5454	3600

Material:	Housing	ASTM A 283 carbon steel
	Blades	1704 pH stainless steel
Bearings		Anti friction ball type, 100,000 hour B-10 Rating Life
Codes		ASME IX and DWS D1.1 for welding

2. Fan Motors

Quantity	One per fan
Horsepower	125 HP/83 HP
Voltage and type	460 volt, 60 Hz, 3 phase induction type
Insulation	Class H Type RN (tested to radiation exposure of 2 x 10^8 rad)
Enclosure and Ventilation	Totally enclosed air over motor
Speed RPM	1770/1170
Start up time for full speed	Max. 10 seconds

3. Cooling Coils

Number of coil banks	Two banks of 4 coils each
Type	Horizontal tube, vertical plate fin

TABLE 6.2-38 (cont'd)

3. Cooling Coils (cont'd)

Face area, ft^2	112
Tube material	ASME SB-75 Alloy 122
Tune O.D., in	5/8
Minimum wall thickness in	0.049
Fins per inch	6
Coil Frame Material	ASME SA-240 Type 304
Coil Header Material	ASME SB-42 Alloy 122
Stub and Flange Material	ASME SB-466 Alloy 706
Code	ASME III, Class 2

	Normal Conditions	Post-LOCA** Condition
Heat removal capacity, BTU/hr/unit	1×10^6	61.6×10^6
Air Temperature, inlet/outlet	120/103.2	264/257.3
Component water temperature, inlet/outlet/F	100/101.8	100/206.4
Component cooling water flow each, gpm	1200	1200
Fouling factor	.001	.0005

4. Other

Lubricants	Bearing lubricants have been tested to radiation exposure of 2×10^8 rad
Housing	Constructed of carbon steel with structural steel reinforcing

** Note that these values represent conditions specified for procurement purposes. The actual heat load will vary based on the accident Analyses (Ref. 27).

TABLE 6.2-39

MATERIAL OF CONSTRUCTION FOR INSULATION USED INSIDE CONTAINMENT

Component	Materials
Reflective Insulation (R)	
Outside Jacket	Stainless steel
Insulation	Stainless steel foil
Inside Jacket	Stainless steel
Straps	Stainless steel
Fasteners	Stainless steel
Buckles	Stainless steel
Buckle springs	Stainless steel
Support collars	Stainless steel
Support collar springs	Stainless steel
Reactor vessel insulation support structure	Carbon steel and stainless steel
Bolts, nuts, washers	Stainless steel
Encapsulated Insulation (E)	
Type A	
Jacket	Stainless steel
Insulation	Fiberglass
Fasteners	Stainless steel
Type B	
Jacket	Stainless Steel
Insulation	
Pipe Shield	Calcium Silicate/Marinite
Piping Outside Bioshield	Calcium Silicate
Clamps	Stainless Steel

TABLE 6.2-40

LOCATION AND QUANTITY OF MAJOR THERMAL INSULATION MATERIALS INSIDE CONTAINMENT

A. Primary System Equipment

Location	Insulation Type*	Total Estimated Quantity ft^2
Reactor vessel (excluding closure head)	R	1420
R/C pumps	R	4632
Steam Generators	R	6840
Pressurizer	E	1250
Regenerative heat exchanger	E	175
Reactor closure head (L-Panel)	E	292
Reactor closure head (dome)	R	208

B.

Piping Size	Insulation Type*	Total Estimated Quantity linear ft
42 in.	E	30
36 in.	E	22
34 in.	E	300
30 in.	E	150
20 in.	E	200
18 in.	E	32

General Note - All quantities are approximate.

*Note: R = Reflective insulation
E = Encapsulated insulation

TABLE 6.2-40 (Cont'd)

B. Piping Size (Cont'd)	Insulation Type*	Total Estimated Quantity linear ft
12 in.	E	465
10 in.	E	446
8 in.	E	440
6 in.	E	1300
4 in.	E	274
3 in.	E	270
2.5 in.	E	87
2 in.	E	1039
1.5 in.	E	56
1.0 in.	E	1500
3/4 in.	E	2420
1/2 in.	E	77
3/8 in.	E	450

TABLE 6.2-41

FAILURE MODE AND EFFECTS ANALYSIS - CONTAINMENT HEAT REMOVAL SYSTEM

Component Identification And Quantity	Failure	Effect on System	Method of Detection	Monitor	Remarks
Containment spray pump (2)	Fails to start	Loss of 100% capacity spray substation	Pump start failure/ CSAS override and pump motor overload alarm/trip	CRI	One 100% capacity spray subsystem operable supplemented by the containment cooling system
Spray Line Flow Control Valve FCV-07-1A/B (pneumatic) (2)	Loss of air supply	No effect on system-fail opens valves	Full flow indication upstream of valve and valve position indicating llights.	CRI	
	Fails to open	Loss of one 100% capacity spray subsystem	No flow indication upstream of valve and valve position indicating lights. Low Header Pressure alarm	CRI	One 100% capacity spray subsystem remains operable supplemented by containment cooling system.
Sump recirculation suction line valve MV-07-2A/B	Fails to open on RAS	Loss of one 100% capacity recirculation mode subsystem	Loss flow indication and low pressure alarm downstream of HX – valve position indicating lights. Failure to open alarm	CRI	One 100% capacity recirculation mode subsystem remains operable supplemented by the containment cooling system.
Refueling water tank suction line valve MV-07-1A,B (2)	Fails to close After RAS	No effect on spray subsystem-recirculating mode will be operating	Valve position indicating lights Failure to close alarm	CRI	Check valves V07119 & V07120 prevent spray water flow from containment sump back to refueling water tank
Component Cooling Water pump (2)	Loss of cooling water	Loss of two fan coolers and one shutdown heat exchanger	Containment airflow high temperature alarm and CCW low flow alarm	CRI	Two containment fan coolers and one containment spray substation remain operable.
Containment cooling Fan (4)	Falls to start	Loss of one containment fan cooler	Containment fan cooler low airflow alarm	CRI	Three remaining fan coolers and two containment spray subsystem are operable
Diesel generator set (2)	Fails to start	Loss of half of the containment heat removal system	Diesel generator malfunction alarm	CRI	One diesel generator set remains operable supplying power to one full capacity spray substation and two containment fan coolers.

CRI – Control room Indication
HX – Heat exchanger
CCW – Component cooling water
RAS– Recirculation actuation signal

TABLE 6.2-42

CONTAINMENT SPRAY-PUMP NPSH DATA

	Injection Phase (Suction From Refueling Water Tank)	Recirc Phase (Suction From Sump)
Elevation of Pump Suction, Ft	-4.82	-4.82
Elevation of Source, Ft	21.06	23.38
Fluid Temperature, F	124	192
Fluid Vapor Pressure, Ft	4.4	23.3
Head Loss Due to Friction, Ft	3.6	2.12
NPSH Available, Ft	48.5	32.42
NPSH Required at Pump Runout, Ft	31.8	23.9
Sump Loss (P_b), Ft		2.79
Pump Flow, gpm	3642	4350

The following formula is used:

$$NPSH\ (\text{available}) = Pt - Pv = Pa + Ps + Pe - Pi - Pv - P_b$$

where:
- Pt = pressure at pump suction centerline
- Pv = vapor pressure of pumped water
- Pa = Air pressure
- Ps = Steam pressure
- Pe = Elevation pressure
- Pi = Head loss due to friction in the suction piping
- P_b = head loss due to sump

TABLE 6.2-43

SPRAY NOZZLE DESIGN DATA

Flow Rate gpm	vs	Pressure Drop Across Nozzle psi
7.71		10
10.95		20
13.54		50
15.20		40 Design Point
17.30		50

Spray Angle = 60 Degrees

Droplet Size at Design Pressure Drop of 40 psi [1], microns	
Maximum Diameter	1629
Minimum Diameter	70
Area Mean Diameter	46
Sauter Mean Diameter	690
Median Diameter	346
Area Length Mean Diameter	634
Volume Length Mean Diameter	610

[1] See Subsection 6.5.2

TABLE 6.2-44

PERFORMANCE OF CONTAINMENT COOLING SYSTEM
LOCA CONDITION

	Air/Steam Temperature (F)	Temperature of Component Cooling Water (F) 60	80	90	100	105	110
Heat Removal in BTU/hr x 10^6	80	2.476	1.455				
	120	10.245	7.288	5.681	3.915	-	2.015
	200	42.81	37.62	34.84	32.04	-	28.943
	280	82.67	76.15	72.59	69.3	-	65.622
Condensate Temperature in F	80	63.42	82.287	-	-	-	-
	120	76.876	92.647	99.743	106.85	110.26	-
	200	157.924	163.928	167.22	170.27	171.81	-
	280	255.55	257.26	258.11	259.3	259.67	-
Condensate Removal Rate in lb/hr	80	1483	1001.44	-	-	-	-
	120	7639	5685	4498	3157	2426	-
	200	40652	35875	33210	30740	29437	-
	280	87150	80271	76424	72954	70958	-

TABLE 6.2-45
INSTRUMENTATION APPLICATION CONTAINMENT HEAT REMOVAL SYSTEMS

Parameters Associated With the System	Indication Local	Indication Control Room	Alarm Local	Alarm Control Room	Recorder[1]	Range[2]	Instrument Normal Operation	Accuracy[2]
CCS Air								
1. Temperature entering					TR-25-1A TR-25-1B		105-120ºF	
2. Temperature leaving				HI	TR-25-1A TR-25-1B		105-120ºF	
3. Flow-Fan Discharge				LO				
4. Fan Vibration (excessive)				HI				
Cooling Unit CCW								
1. Temperature downstream					TR-09-5A		60-100ºF	
2. Flow - downstream	FIS-14-12A, 12B, 12C, 12D			LO			›1,200 gpm	
CS Pump 2A & 2B								
1. Motor current		AM/287 AM/290					66 Amp 66 Amp	
2. Pressure-Pump Suction		PI-07-4A/5A			UR-07-1B		10-35 psig	
3. Pressure-Pump Discharge	PI-07-1A PI-07-1B	PIS-07-3A PIS-07-3B		LO			180-270 psig 180-270 psig	
4. Flow-Pump Discharge		FI-07-1A FI-07-1B			FR-07-1A FR-07-1B		2700-3800 gpm 2700-3800 gpm	

(1) All recordings are in the control room unless otherwise indicated.
(2) Instrument ranges are selected in accordance with standard engineering practices. Instrument accuracies are selected such that existing instrument loop performance and safety analysis assumptions remain valid. Where applicable, instrument accuracies are also evaluated for their impact on setpoints in accordance with the FPL Setpoint Methodology.

TABLE 6.2-46

CONTAINMENT HEAT REMOVAL SYSTEM ALARMS[1]

CS PUMP 2A & 2B

Motor overload (Pump trip)

Start Failure
CSAS override

FCV-07-1A & 1B
Fail to open

REFUELING WATER TANK

MV-07-1A & 1B closed
Motor overload,
Fail to close on RAS

CONTAINMENT SUMP

MV-07-2A & 2B open
Motor overload,
Fail to open on RAS

CONTAINMENT FAN COOLERS

Temperature Leaving - High
Fan Discharge Flow - Low
Fan Vibration - High (Excessive)
CCW Flow - Low
Motor Overload/Trip
SIAS Override/Control Switch Stop/SS Isolation

[1]ALL alarms are in control room unless otherwise indicated.

TABLE 6.2-47

SHIELD BUILDING DESIGN AND PERFORMANCE DATA

I. Annulus Free Volume, 5.47×10^5 ft^3

II. Pressure

1. Normal Operation: Atmospheric

2. Post accident: 1.75 in. wg. negative to 2.0 in. wg. negative

III. Leak Rate at Post Accident Pressure

1. From containment - 0.5% for the first 24 hrs
0.25%/day thereafter

2. From outside environs - 5% per day at 0.25 in. wg.
pressure differential

IV. Exhaust Fans

. 1 Number - 2

2. Type - Centrifugal type, direct-driven with airfoil blades.

V. Filter Trains

1.	First electric heater each train	1.5 kw
2.	Demister each train	99% efficiency
3.	Second electric heater each train	30 kw
4.	HEPA prefilters each train	99.97% efficiency
5.	Charcoal adsorber	99% efficiency gasketless
6.	HEPA after- filters each train	99.97% efficiency

TABLE 6.2-48

DESIGN DATA FOR SHIELD BUILDING VENTILATION SYSTEM COMPONENTS (HVE-6A & 6B)

1. SBVS Fans

Quantity	2
Type	Centrifugal type, direct-driven with airfoil blades
Material	Carbon steel
Actual air flow at inlet, per fan, cfm	6000 nominal
Air density, lb/ft^3	0.075
Static pressure, inches wg.	21

Fan performance, each (see Figure 6.2-52)

Capacity (cfm)	Static Pressure (in.wg)
6,000	21
6,500	19
6,750	17.6
7,500	14

Code	Air Moving and Conditioning Association (AMCA), Anti-Friction Bearing Manufacturer's Association (AFBMA) Welding per AWS D1.1 and ASME IX

2. Motors

Quantity	2, one per fan
Type	60 hp, 480 volt, 60 Hz, 3 phase horizontal induction type
Insulation	Class H
Enclosure & Ventilation	Drip-proof
Code	NEMA

3. 1st Electric Heater

Quantity	2, one per train
Size, KW	1.5 (480V, 3 phase, 60 Hz)

4. Demister Cells

Quantity	12, 6 per filter train

TABLE 6.2-48 (Cont'd)

4. Demister Cells (Cont'd)

Air Flow, cfm	6,000 per filter train
Face velocity, fpm	284.4
Cell size	24 in. high, 24 in. wide, 6 in. deep
Cell arrangement	2 wide x 3 high
Maximum pressure drop dry,in. wg.	1.0
Maximum pressure drop wet,in. wg.	2.0
Design dry bulb/rel. humidity, F/percent	260/100
Efficiency	99 percent when exposed to entrained water particles of 1 to 5 microns in size
Material	Stainless steel casing, fiberglass pads

5 2nd Electric Heater

Quantity	2, one per filter train
Size, kw	30 (480V, 3 phase, 60 Hz)

6. HEPA Filters

Quantity	24, 12 per filter train
Location	6 pre-HEPA and 6 after-HEPA
Air flow, cfm	6000 per filter train
Cell size	24 in. high, 24 in. wide, 11 1/2 in. deep
Cell arrangement	2 wide x 3 high
Maximum pressure drop clean, in. wg.	1.0
Maximum pressure drop loaded, in. wg.	3.0
Efficiency	99.97 percent when tested with 0.3 micron DOP

TABLE 6.2-48 (Cont'd)

6. HEPA Filters (Cont'd)

Material	Pleated glass paper without separator, enclosed in stainless steel frame ASTM A268, alternate design includes Aluminum Separators
Make	Flanders 7023-NU-GGF or equivalent
Construction Standard	MIL-F-51068D and MIL-F-51079A ASME AG-1

7. Charcoal Adsorbers

Make and type	CVI HECA Module
Cell construction	Vertical
Material	Adsorber, activated coconut shell; charcoal enclosure, stainless steel, ASTM A240, Type 304
Bulk Density (bone dry),	.38 g/ml minimum tested per ASTM D2854
Loading capacity	2.5 mg of iodine per gram of charcoal
Particle size distribution	10 through 14 mesh
Plenum size	60 in. deep x 96 in. high x 66 in. wide
Bed arrangement	3 wide x 1 high
Bed thickness, in. nominal	2
Amount of charcoal, lb	2362, 1181 lb per filter train
Air flow, cfm	6000 per filter train
Efficiency	90 % for radioactive methyl when tested In accordance with ASTM D3803-1989
Maximum pressure drop in. wg.	1.35
Nondestructive test	USNRC Bulletin No. 120 and ANSI N510-1980

8. Ducts

Material	Galvanized sheet metal, ASTM A526; Structural shapes ASTM A36

TABLE 6.2-49

DESCRIPTION OF ASSUMPTIONS USED IN SHIELD BUILDING ANNULUS TRANSIENT ANALYSES

I. Secondary Containment Design

Refer to Table 6.2-47 for analysis data regarding the Shield Building.

II. Transient Analysis	Primary	Secondary
A. Initial Conditions		
1. Pressure, psia	14.7	14.7
2. Temperature, F	120	120
3. Humidity (percent)	45	100
4. Constant outside air pressure		14.7
5. Constant outside air temperature, F		101
6. Constant outside humidity (percent)		100
7. Steel cylinder and dome internal radii, ft		70
8. Steel building and concrete shield building		
Cylinder heights:		
From annulus floor to midpoint (effective height of secondary shield wall), ft.		53
From midpoint (effective height secondary shield wall) to springline, ft		74.1
9. Thickness of steel cylinder, in.		1.92
10. Thickness of steel dome, in.		.96
11. Thickness of concrete shield building cylinder , ft		3.0
Thickness of concrete shield building top (for heat transfer calculation to 59.644% of a sphere with a 74 ft radius) (ft)		2.5

TABLE 6.2-49 (Cont'd)

B.	Thermal Characteristics		Secondary
	1.	Primary Containment Wall	
		a. Coefficient of temperature Linear Expansion in/in-F	0.65×10^{-5}
		b. Modulus of Elasticity, psi	$30. \times 10^{6}$
		c. Poissons Ratio	0.3
		d. Thermal Conductivity, BTU/hr-ft-F	25.9
		e. Thermal Capacitance, BTU/ft^3-F	53.57
	2.	Secondary Containment Wall	
		a. Thermal Conductivity, BTU/hr – ft- F	1.0
		b. Thermal Capacitance, BTU/ft^3-F	31.9
	3.	Heat Transfer Coefficients	
		a. Containment vapor to steel Vessel (BTU/hr – ft^2-F)	4 x Tagami heat transfer co-efficient
		b. Steel Cylinder 2 to annulus air (BTU/hr-ft^2-F)	GOTHIC Heat Transfer Option
		c. Steel dome to annulus air (BTU/hr-ft^2-F)	GOTHIC Heat Transfer Option
		d. Annulus air to concrete cylinde (BTU/hr-ft^2-F)	GOTHIC Heat Transfer Option
		e. Annulus air to concrete dome (BTU/hr-ft^2-F)	GOTHIC Heat Transfer Option
		f. Primary Containment Emissivit	0.9
		g. Secondary Containment Emissivity	0.9
		h. Concrete cylinder to outside air (BTU/hr-ft^2-F)	0.0
		i. Concrete dome to outside air (BTU/hr-ft^2-F)	0.0
C.		Additional Heat Sources in Shield Building Annulus	
	1.	SBVS filter heaters and pump motor (kW)	76.26

TABLE 6.2-50

FAILURE MODE AND EFFECT ANALYSIS - SHIELD BUILDING VENTILATION SYSTEM

Component Identification and Quality	Failure Mode	Effect on System	Method of Detection	Monitor	Remarks
1. Damper downstream of fan (2) (D-23 or D-24)	Fails to modulate	None	Air flow indicator downstream of fan	CRI*	No impact; this damper is normally open and is designed to open upon failure of control power.
2. Filter train (2) or component	Clogs	Loss of one fan and filter subsystem	Low air flow alarm downstream of fan and differential pressure on 1st HEPA	CRI	One 100% capacity fan and filter subsystem operable.
3. Outside cooling air valve (2)	Fails to open	Subsystem will operate satisfactorily until charcoal adsorber temperature reached 200°F.	High temperature alarm on charcoal adsorbers and valve position indicator	CRI	One 100% capacity fan and filter subsystem operable. Cross connect will supply required cooling air from annulus space to inoperable train.
4. Fan (2) (HVE-6A or 6B)	Fails to start	Loss of one fan and filter subsystem	Low air flow alarm and indicator downstream of fan	CRI	One 100% capacity fan and filter subsystem operable.
5. Diesel generator set (2)	Fails to start	Loss of one fan and filter subsystem	Diesel generator malfunction alarm	CRI	One 100% capacity fan and filter subsystem operable.
6. Fuel Handling Building isolation valve (2) in the SBVS suction header (FCV-25-30 or 31)	Spurious signal opens or failure to close on CIS after opening for fuel handling high radiation initiation	Partial loss of suction in the annulus	Valve position indicator and annulus high pressure indicator and alarm	CRI	One 100% capacity, fan and filter subsystem operable.
7. Hydrogen purge isolation valve (2) in the SBVS suction header (FCV-25-29 or 34)	Spurious signal opens or failure to close after purge	None	Valve position indicator	CRI	One 100% capacity and filter subsystem operable.
8. SBVS suction valve (2) (FCV-25-32 or 33)	Spurious signal closes or failure to open on CIS after fuel handling high radiation initiation	Loss of suction in one fan and filter subsystem	Low air flow alarm and indicator downstream of fan valve position indicator	CRI	One 100% capacity fan and filter subsystem operable.
9. Loss of 30 kw heating coil (2) (EHC-HVE-6A1 or 6B1)	Will not operate	Reduction of methyl iodide removal efficiency	High humidity alarm	CRI	One 100% capacity fan and filter subsystem available.

*CRI - Control Room Indication

TABLE 6.2-50 (Cont'd)

Component Identification and Quality	Failure Mode	Effect on System	Method of Detection	Monitor	Remarks
10. Decay heat cooling valve (1) on interconnecting pipe (FCV-25-13)	Closed and cannot be reopened	Loss of decay heat cooling air	High charcoal temperature alarm, valve position indicator	CRI	This is unlikely to happen because the valve is normally open and fails as-is. Both fans are available to supply cooling air.
11 Loss of operating filter train	Will not operate	Loss of one fan and filter subsystem	Low air flow alarm and indication downstream of fan	CRI	One 100% capacity fan and filter subsystem are available and a 1.5 kW heating coil powered from the opposite bus precludes desorption due to humidity on the inoperable train.

TABLE 6.2-51

SHIELD BUILDING VENTILATION SYSTEM INSTRUMENTATION APPLICATION

	System Parameter & Location	Indication Local	Indication Control Room	Alarm Control Room	Control Room Recording	Automatic Control Function	Instrument[1] Range	Normal Operating Range	Instrument[1] Accuracy
1.	Annulus/atmosphere pressure differential		*	Hi-Lo		Energizes fan discharge damper motor and regulates flow to preset value and energize outside cooling air valve		-1 to -3 in. H_2O	
2.	Fuel pool area/atmosphere pressure differential		*	Hi-Lo		Energizes fan discharge damper motor and regulates flow to preset value and energize outside cooling air valve		-1 to -3 in. H_2O	
3.	Air flow temperature downstream of demister	*						40-177 F	
4.	Inlet temperature upstream of filter train	*						40-177 F	
5.	Demister & Electric Heaters differential pressure	*						0.15-2 in. H_2O	
6.	Air flow temperature downstream of 30 Kw heating coil				*			40-177 F	
7.	Pre-HEPA filter differential pressure	*	*	Hi	*			1 to 3 in. H_2O 1 to 3 in. H_2O	
8.	After-HEPA filter differential pressure	*			*			1 to 3 in. H_2O 1 to 3 in. H_2O	
9.	Air flow moisture downstream of pre-HEPA filter			Hi				50-70%	
10.	Charcoal adsorber differential pressure indicator	*			*			1 to 1.35 in. H_2O 1 to 1.35 in. H_2O	
11.	Charcoal adsorber temperature			Hi	*			40-177 F	
12.	Air flow temperature downstream of charcoal adsorbers	*			*			40-177 F	

TABLE 6.2-51 (Cont'd)

System Parameter & Location	Indication Local	Indication Control Room	Alarm Control Room	Control Room Recording	Automatic Control Functior	Instrument[1] Range	Normal Operating Range	Instrument[1] Accuracy
13. Air flow downstream of fan or Air flow of filter train	*	*	*	*	Energize, idle fan to start, at low flow and alarms		6000 cfm	
14. Filter train differential pressure				*			4 to 8 in. H_2O	
15. Cross-connect flow control valve position		*					-	
16. Outside cooling air flow control valve position		*					-	
17. Shield building suction valve position		*					-	
18. Fuel handling building suction valve position		*					-	
19. Purge discharge valve position		*					-	

(1) Instrument ranges are selected in accordance with standard engineering practices. Instrument accuracies are selected such that existing instrument Loop performance and safety analysis assumptions remain valid. Where applicable, instrument accuracies are also evaluated for their impact on setpoints in accordance with the FPL Setpoint Methodology.

TABLE 6.2-52

CONTAINMENT PENETRATION AND ISOLATION VALVE INFORMATION

Penetra-tion No.	System	GDC (UFSAR) Classification	Fluid	Line Size (In.)	ESF	Leak[1][2][5] Testing	UFSAR Figure	Valve Number	Location	Pipe Length [3] to Containment (Ft)	Valve Type	Valve Operator
1, 2	Main Steam	GDC-57 (C)	Steam	34 3	No No	-	10.1-1	HCV-08-1A, B MV-08-1A, B	Out Out	52 52	Stop Globe	Piston Motor
1, 2	AFW PP 2C Warm-Up Line		Steam	3/4	No			SE-08-1, 2	Out		Globe	Solenoid
1, 2	Main Steam/Aux. FW	GDC-57 (C)	Steam	4	Yes	-		MV-08-12, 13	Out		Gate	Motor
3, 4	Feedwater	GDC-57 (C)	Water	20	No	-	10.1-2	HCV-09-1A, 1B, 2A, 2B	Out	27	Gate	Electro-hydraulic
3,4	Auxiliary Feedwater	GDC-57 (C)	Water	4	Yes	-	10.1-2	MV-09-9, 10, 11, 12	Out	44	Globe	Motor
5, 6	Steam Generator Blowdown	GDC-57 (C)	Water	2	No	-	10.4-6	FCV-23-3, 5	Out	11.0	Globe	Diaphragm
7[6]	Primary Makeup	GDC-56 (A1)	Water	2	No	BL-C BL-C	9.2-4	HCV-15-1[7] V15328	Out In	17	Globe Check	Diaphragm
8	Station Air	GDC-56 (A1)	Air	2	No	BL-C BL-C BL-C	9.3-1	HCV-18-2[7] V181270 SH18797[7]	Out In Annulus	11.0 2.0	Globe Check Ball	Diaphragm
9	Instrument Air	GDC-56 (A1)	Air	2	No	BL-C BL-C	9.3-2	HCV-18-1[7] V18195	Out In	9.0 1.5	Globe Check	Diaphragm
10	Cont Purge Exhaust	GDC-56 (A2)	Air	48 48	No No	-C -C	9.4-9	FCV-25-5[7] FCV-25-4[7]	Annulus In	1.0 3.0	B'fly B'fly	Piston Piston
11	Cont Purge Supply	GDC-56 (A2)	Air	48 48	No No	-C -C	9.4-9	FCV-25-2[7] FCV-25-3[7]	Annulus In	1.0 3.0	B'fly B'fly	Piston Piston
12, 13	Spare											
14	N2 Supply to Reactor Containment Building	GDC-56 (A1)	N_2	1	No	BL-C BL-C	11.3-1	V6741[7] V6792	Out In	16	Globe Check	Diaphragm
15, 17, 19, 21	Cont Fan Coolers Cooling Water	GDC-57 (C)	Water	8	Yes	-	9.2-2	MV-14-10, 12, 14, 16	Out	13	B'fly	Motor
16, 18, 20, 22	Cont Fan Coolers Cooling Water	GDC-57 (C)	Water	8	Yes	-	9.2-2	MV-14-9, 11, 13, 15	Out	13	B'fly	Motor
23[6]	RC Pump Cooling Water Supply	GDC-56 (A1)	Water	8	No	BL-C BL-C(R)	9.2-2	HCV-14-7[7] HCV-14-1[7]	Out In	12.5 7.0	B'fly B'fly	Piston Piston
24[6]	RC Pump Cooling Water Return	GDC-56 (A1)	Water	8	No	BL-C BL-C(R)	9.2-2	HCV-14-6[7] HCV-14-2[7]	Out In	12.5 7.0	B'fly B'fly	Piston Piston

TABLE 6.2-52 (Cont'd)

Penetra-tion No.	System	GDC (UFSAR) Classification	Fluid	Line Size (In.)	ESF	Leak[1][2][5] Testing	UFSAR Figure	Valve Number	Location	Pipe Length [3] to Containment (Ft)	Valve Type	Valve Operator
25	Fuel Transfer Tube	--	Water	36	No	BL-B		--	In			Double Gasketed Flange
26	CVCS (letdown)	GDC-55 (B1)	Water	2	No	BL-C BL-C	9.3-5c 9.3-5a	V2516 V2522	In Out	- 12	Globe Globe	Diaphragm Diaphragm
27	CVCS (charging)	GDC-55 (E)	Water	2	Yes	-	9.3-5c	V2462 V2523	In Out	2 11	Check Globe	- Diaphragm
28A	Safety Injection Tank Sample	GDC-55 (B1)	Water	3/8	No	BL-C BL-C	9.3-3a	SE-05-1A[7], 1B[7], 1C[7], 1D[7] SE-05-1E[7]	In Out	10 5	Globe Globe	Solenoid Solenoid
28B	RCS Hot Leg Sample	GDC-55 (B1)	Water	3/8	No	BL-C BL-C	9.3-3a	V5200[7] V5203[7]	In Out	10 15	Globe Globe	Solenoid Diaphragm
29A	Press. Surge Sample	GDC-55 (B1)	Water	3/8	No	BL-C BL-C	9.3-3a	V5204[7] V5201[7]	Out In	5 2	Globe Globe	Diaphragm Solenoid
29B	Press. Steam Sample	GDC-55 (B1)	Water	3/8	No	BL-C BL-C	9.3-3a	V5205[7] V5202[7]	Out In	15 10	Globe Globe	Diaphragm Solenoid
30, 49	Steam Generator Blow-down Sampling	GDC-57 (C)	Water	1/2	No	-	10.4-6, 7	FCV-23-7, 9	Out	15	Globe	Diaphragm
31	Containment Vent Header	GDC-56 (A1)[4]	N_2	1	No	BL-C BL-C	11.3-1	V6718[7] V6750[7]	In Out	10 15	Diaph Diaph	Diaphragm Diaphragm
32, 33	Containment Sump Suction	GDC-56 (E)	Water	24	Yes	-	6.2-41	MV-07-2A, 2B	Out	12	B'fly	Motor
34A & B, 35A & B	Containment Spray	GDC-56 (E)	Water	12 10	Yes Yes	- -	6.2-41	FCV-07-1A, B V07193, V07192	Out In	16, 20 11, 7	B'fly Check	Diaphragm 36-49
36-39	Safety Injection	GDC-55 (E)	Water	6	Yes	-	6.3-1	HCV-3615, 3625, 3635, 3645, HCV-3616, 3626, 3636, 3646, HCV-3617, 3627, 3637, 3647 V3258, 3259, 3260, 3261	Out In	- -	Globe Check	Motor
40, 64	Shutdown Cooling	GDC-55 (B2)	Water	10	Yes	-	6.3-1b	V3665, 3664 V3651, 3481 V3652, 3480	Out In In	14.0 80	Gate Gate Gate	Motor Motor Motor
41	SIT Test Line	GDC-55 (B2)	Water	2	No	BL-C BL-C	6.3-1a	SE-03-2A[7], 2B[7] V3463[7]	In Out	10.0, 6x4 11.0, 12	Globe Gate	Solenoid -
42[6]	Reactor Cavity Sump Pump Discharge	GDC-56 (A1)[4]	Water	2	No	BL-C BL-C	6.2-41	LCV-07-11A[7] LCV-07-11B[7]	In Out	4.0 15	Globe Globe	Diaphragm Diaphragm

TABLE 6.2-52 (Cont'd)

Penetra-tion No.	System	GDC (UFSAR) Classification	Fluid	Line Size (In.)	ESF	Leak(1)(2)(5) Testing	UFSAR Figure	Valve Number	Location	Pipe Length (3) to Containment (Ft)	Valve Type	Valve Operator
43	RCDT Pump Suction	GDC-56 (A1)	Water	3	No	BL-C BL-C	11.2-1	V6341(7) V6342(7)	In Out	80.0 9.0	Diaph Diaph	Diaphragm Diaphragm
44(6)	RCP Controlled Bleed-off	GDC-55 (B1)	Water	3/4	No	BL-C BL-C	9.3-5b	V2524(7) V2505(7)	In Out	4.0 15.0	Globe Globe	Diaphragm Diaphragm
45, 53	Fluid Inst Line	RG 1.11(D)	Air	3/8	No	-	6.2-41	Excess Flow	Out	15.0	Check	-
45B, 53B	Fluid Inst Line (Does not penetrate containment)											
46(6)	Fuel Pool Cleanup (Return)	GDC-56 (A2)	Water	3	No	BL-C BL-C	6.2-41	V07206(7) V07189(7)	Out In	11.0 10.0	Gate Gate	- -
47(6)	Fuel Pool Cleanup (Supply)	GDC-56 (A2)	Water	3	No	BL-C BL-C	6.2-41	V07170(7) V07188(7)	Out In	11.0 10.0	Gate Gate	- -
48A, 51A	Hydrogen Sample Lines (Outlet)	GDC-56 (E)	Air	3/8	Yes	BL-C BL-C	12.3-14	FSE-27-8(7) to 14(7) FSE-27-15(7), 18(7)	In Out	10.0 15	Globe Globe	Solenoid Solenoid
48, 51	Fluid Instrument Line	RG 1.11 (D)	Air	3/8	No	-	6.2-41	Excess flow	Out	-	Check	
48B, 51B	Hydrogen Sample Lines (Inlet)	GDC-56 (E)	Air	3/8	Yes	BL-C BL-C	12.3-14	V27101 & V27102 FSE-27-16(7), 17(7)	In Out	10.0 15.0	Check Globe	- Solenoid
48, 51	Containment Pressure	RG 1.11 (D)	Air	3/8	No	-	6.2-41	SE-07-5E, 5F	Out	-	Globe	Solenoid
49	Refer to Penetration 30											
50	Spare											
51	Refer to Penetration 48											
52A	Containment Radiation Monitoring	GDC-56 (A1)	Air	1	No	BL-C BL-C	12.3-14	FCV-26-1(7) FCV-26-2(7)	In Out	10.0 15.0	Globe Globe	Diaphragm Diaphragm
52B	Containment Radiation Monitoring	GDC-56 (A1)	Air	1	No	BL-C BL-C	12.3-14	FCV-26-3(7) FCV-26-4(7)	In Out	10.0 15.0	Globe Globe	Diaphragm Diaphragm
52C	Containment Radiation Monitoring	GDC-56 (A1)	Air	1	No	BL-C BL-C	12.3-14	FCV-26-5(7) FCV-26-6(7)	In Out	10.0 15.0	Globe Globe	Diaphragm Diaphragm
52D	ILRT	GDC-56 (A2)	Air	1	No	BL-C BL-C		V00140(7) V00143(7)	In Out	10.0 15.0	Globe Globe	- -
52E	ILRT	GDC-56 (A2)	Air	3/8	No	BL-C BL-C		V00139(7) V00144(7)	In Out	10.0 15.0	Globe Globe	- -

TABLE 6.2-52 (Cont'd)

Penetration No.	System	GDC (UFSAR) Classification	Fluid	Line Size (In.)	ESF	Leak[(1)(2)(5)] Testing	UFSAR Figure	Valve Number	Location	Pipe Length [(3)] to Containment (Ft)	Valve Type	Valve Operator
53	Refer to Penetration 45											
54	ILRT	GDC-56 (A2)	Air	8	No	BL-C BL-C(R)		V00101[(7)]	Out In	11.0	Gate Flange	-
55	Containment Pressure	RG 1.11 (D)	Air	3/8	No	-	6.2-41	SE-07-5A	Out	-	Globe	Solenoid
56	Cont Containment/ H_2 Purge - Makeup Inlet	GDC-56 (A1)	Air Air	8 8	No No	BL-C BL-C	9.4-11 9.4-11	FCV-25-26[(7)] FCV-25-36[(7)]	Out In	3 2	B'fly B'fly	Piston Piston
57	Cont Containment/ H_2 Purge - Exhaust	GDC-56 (A1)	Air	8	No	BL-C	9.4-11	FCV-25-20[(7)] FCV-25-21[(7)]	In Out	2 9	B'fly B'fly	Piston Piston
58	Containment Press (Inst)	RG 1.11 (D)	Air	3/8	No	-	6.2-41	SE-07-5C	Out	-	Globe	Solenoid
59, 60	Shield Building Vent (Does not penetrate containment vessel)											
61	Spare											
62	HVAC Instr - (Does not pentrate containment)											
63	Spare											
64	Refer to Penetration 40											
65, 66	HVAC Instr - (Does not penetrate containment)											
67, 68	Containment Vacuum Relief	GDC-56 (A1)	Air	24	Yes	-C -C	9.4-9	V-25-20, 21 FCV-25-7, 8[(7)]	In Out	1 1	Check B'fly	- Piston
69	Hot Leg Injection	GDC-55 (B2)	Water	3	Yes	-	6.3-1a & b	V3540 V3524	Out In	18 150	Globe Check	Motor -
70	Hot Leg Injection	GDC-55 (B2)	Water	3	Yes	-	6.3-1a & b	V3523 V3526	Out In	36 86	Globe Check	Motor -
71, 72	Cont Press Inst	RG 1.11 (D)	Air	3/8	No	-	6.2-41	SE-07-5D, 5B	Out	-	Globe	Solenoid

TABLE 6.2-52 (Cont'd)

Footnotes for Table

(1) Type C testing is defined in 10 CFR 50, Appendix J and/or Appendix J, Option B.

(2) BL - Bypass leakage.

(3) Length of pipe is measured from steel containment to outermost isolation valve outside containment.

(4) Although this is a class A1 penetration, the piping is seismic Category I on both sides of containment.

(5) (R) - Tested with pressure applied in reverse direction to that experienced under DBA.

(6) Thermal relief valve(s) provided to address thermal overpressurization concerns of NRC Generic Letter 96-06.

(7) Valve covered by Technical Specification 3/4.6.3.

TABLE 6.2-53
CONTAINMENT ISOLATION ANALYSIS *

Penetration No.	System	Valve Type	Containment Isolation Actuation Signal (1)	Primary Actuation Mode(2)	Secondary Actuation Mode (2)	Normal Valve Position(3)	Shutdown Valve Position(3)	Post-Accident Valve Position(3)	Power Failure Valve Position	Time to Close (sec)	Power Source
1, 2	Main Steam	Stop Globe	MSIS MSIS	P E	- M	Open Closed	Closed Closed	Closed Closed	As is As is	5.6 30	125 DC 480 AC
1, 2	AFW PP 2C Warm-Up Line	Gate	-	-	M	Open	Open	Open	Open	-	125 DC
1, 2	Main Steam/Aux FW	Gate	-	E	M	Closed	Open	Open	As is	30	125 DC
3, 4	Feedwater	Gate	MSIS AFAS	H	-	Open	Closed	Closed	As is	4.0	125 VDC
3, 4	Auxiliary Feedwater	Globe	AFAS	E	M	Closed	Open	Open	As is	-	480 AC
5, 6	Steam Generator Blowdown	Globe	CIS/A	P	M	Open	Closed	Closed	Closed	5	125 DC-SA
7	Primary Makeup Water	Globe Check	CIS/B -	P Self	M -	Open -	Closed	Closed	Closed	5 -	125 DC-SB
8	Station Air	Globe Check Ball	CIS/A - -	P Self M	M - -	Closed - Closed	Open - Closed	Closed - Closed	Closed - -	5 - -	125 DC-SA
9	Instrument Air	Globe Check	CIS/A -	P Self	M -	Open -	Closed -	Closed -	Closed -	5 -	125 DC-SA
10	Cont Purge Exhaust	B'fly B'fly	CIS/B CIS/A	P P	M M	Closed Closed	Closed Closed	Closed Closed	Closed Closed	5 5	125 DC-SB 125 DC-SA
11	Cont Purge Supply	B'fly B'fly	CIS/A CIS/B	P P	M M	Closed Closed	Closed Closed	Closed Closed	Closed Closed	5 5	125 DC-SA 125 DC-SB
12, 13	Spare										
14	N2 Supply to Reactor Containment Bldg.	Globe Check	CIS/B -	P Self	M -	Closed -	Open -	Closed -	Closed -	5 -	125 DC-SB -
15,17 19, 21	Cont Fan Coolers Cool. Water Return	B'fly	-	E	M	Open	Open	Open	As is	30	480 AC
16, 18 20, 22	Cont Fan Coolers Cooling Water Supply	B'fly	-	E	M	Open	Open	Open	As is	30	480 AC
23	RC Pump Cooling Water Supply	B'fly B'fly	SIAS/B SIAS/A	P P	M M	Open Open	Closed Closed	Closed Closed	Closed Closed	5 5	125 DC-SB 125 DC-SA
24	RC Pump Cooling Water Return	B'fly B'fly	SIAS/B SIAS/A	P P	M M	Open Open	Closed Closed	Closed Closed	Closed Closed	5 5	125 DC-SB 125 DC-SA
25	Fuel Transfer Tube	-	-	-	-	Closed	-	Closed	-	-	-

*Actual Components may be procured and tested to more conservative stroke times than those listed.

TABLE 6.2-53 (Cont'd)

Penetra-tion No.	System	Valve Type	Containment Isolation Actuation Signal(1)	Primary Actuation Mode(2)	Secondary Actuation Mode (2)	Normal Valve Position	Shutdown Valve Position(3)	Post-Accident Valve Position(3)	Power Failure Valve Position	Time to Close (sec)	Power Source
26	CVCS (letdown)	Globe Globe	SIAS/CIS-A CIS/B	P P	M M	Open Open	Closed Closed	Closed Closed	Closed Closed	5 5	125 DC-SA 125 DC-SB
27	CVCS (charging)	Check Globe	- -	Self P	- -	- LO	- LO	- LO	- LO	- 10	- 125 DC-SA
28A	Safety Injection Tank Sample	Globe Globe	CIS/B CIS/A	S S	M M	Closed Closed	Closed Closed	Closed Closed	Closed Closed	5 5	125 DC-SB 125 DC-SA
28B	RCS Hot Leg Sample	Globe Globe	CIS/A CIS/B	S P	M M	Closed Closed	Closed Closed	Closed Closed	Closed Closed	5 5	125 DC-SA 125 DC-SB
29A	Press. Surge Sample	Globe Globe	CIS/B CIS/A	P S	M M	Closed Closed	Closed Closed	Closed Closed	Closed Closed	5 5	125 DC-SB 125 DC-SA
29B	Press. Steam Sample	Globe Globe	CIS/B CIS/A	P S	M M	Closed Closed	Closed Closed	Closed Closed	Closed Closed	5 5	125 DC-SB 125 DC-SA
30, 49	Steam Generator Blowdown Sampling	Globe	CIS/A	P	M	Open	Closed	Closed	Closed	10	125 DC-SA
31	Containment Vent Header	Diaph Diaph	CIS/B CIS/A	P P	M M	Open Open	Open Open	Closed Closed	Closed Closed	5 5	125 DC-SB 125 DC-SA
32, 33	Containment Sump Suction	B'fly	RAS	E	M	Closed	Closed	Open on RAS	As is	30	480 AC
34A & B 35A & B	Containment Spray	B'fly Check	CSAS -	P Self	M -	Closed -	Closed -	CSAS Opens	Open -	10 -	125 DC-SA/SB
36-39	Safety Injection	Globe Check	SIAS Opens	E Self	M -	Closed -	Open -	Open -	As is -	- -	480 AC -
40, 64	Shutdown Cooling	Gate Gate	- -	- -	- -	LC LC	Open Open	Closed Closed	As is As is	- -	480 AC 480 AC
41	SIT Test Line	Globe Gate	SIAS/CIS -	S -	M	Closed LC	Closed Closed	Closed LC	FC LC	10 -	125 DC-SA/SB -
42	Reactor Cavity Sump Pump Discharge	Globe Globe	CIS/SIAS-A CIS/SIAS-B	P P	M M	Closed Closed	Closed Closed	Closed Closed	Closed Closed	5 5	125 DC-SA 125 DC-SB
43	RCDT Pump Suction	Diaph Diaph	CIS/A CIS/B	P P	M M	Open Open	Closed Closed	FC FC	FC FC	5 5	125 DC-SA 125 DC-SB

TABLE 6.2-53 (Cont'd)

Penetra-tion No.	System	Valve Type	Containment Isolation Actuation Signal[1]	Actuation Mode[2] Primary	Secondary	Normal Valve Position[3	Shutdown Valve Position	Post-Accident Valve Position	Power Failure Valve Position	Closure Time (sec)	Power Source
44	RCP Controlled Bleedoff	Globe	CIS/B	P	M	Open	Closed	FC	FC	5	125DC/SB
		Globe	CIS/A	P	M	Open	Closed	FC	FC	5	125DC/SA
45,53	Fluid Inst Line	Check	-	Self	-	-	-	-	-	-	-
45B,53B	Fluid Inst Line	Does not penetrate containment									
46	Fuel Pool Cleanup (Return)	Gate	-	M	-	LC	Closed	Closed	Closed	-	-
		Gate	-	M	-	LC	Closed	Closed	Closed	-	-
47	Fuel Pool Cleanup (Supply)	Gate	-	M	-	LC	Closed	Closed	Closed	-	-
		Gate	-	M	-	LC	Closed	Closed	Closed	-	-
48A,51A	Hydrogen Sample Lines (Outlet)	Globe	-	S	M	Closed	Closed/Open	Closed/Open	Closed	5	120 AC
		Globe	-	S	M	Closed	Closed/Open	Closed/Open	Closed	5	120 AC
48B,51B	Hydrogen Sample Lines (inlet)	Check	-	Self	-	-	Closed	-	-	-	-
		Globe	-	S	M	Closed	Closed	Closed	Closed	5	120 AC
48,51	Fluid Inst Line	Check	-	Self	-	Open	Open	-	-	-	-
48,51	Cont Press	Globe	-	S	-	Open	Open	Open	Closed	-	125 DC
49	Refer to Penetration 30										
50	Spare										
51	Refer to Penetration 48										
52A	Containment Radiation	Globe	CIS/B	P	M	Open	Closed	Closed	Closed	10	125 DC-SB
	Monitoring	Globe	CIS/A	P	M	Open	Closed	Closed	Closed	10	125 DC-SA
52B	Containment Radiation	Globe	CIS/B	P	M	Open	Closed	Closed	Closed	10	125 DC-SB
	Monitoring	Globe	CIS/A	P	M	Open	Closed	Closed	Closed	10	125 DC-SA
52C	Containment Radiation	Globe	CIS/B	P	M	Open	Closed	Closed	Closed	10	125 DC-SB
	Monitoring	Globe	CIS/A	P	M	Open	Closed	Closed	Closed	10	125 DC-SA
52D	ILRT	Globe	-	M	-	LC	Closed	Closed	Closed	-	-
		Globe	-	M	-	LC	Closed	Closed	Closed	-	-
52E	ILRT	Globe	-	M	-	LC	Closed	Closed	Closed	-	-
		Globe	-	M	-	LC	Closed	Closed	Closed	-	-
53	Refer to Penetration 45										

TABLE 6.2-53 (Cont'd)

Penetration No.	System	Valve Type	Containment Isolation Actuation Signal (1)	Primary Actuation Mode (2)	Secondary Actuation Mode (2)	Normal Valve Position (3)	Shutdown Valve Position (3)	Post Accident Valve Position	Power Failure Valve Position	Time to Close (sec)	Power Source
54	ILRT	Gate	-	M	LC -	Closed -	Closed -	Closed -	- -	- -	
55	Conainment Press (Inst)	Globe	-	S	-	Open	Open	Open	Open	-	125V DC
56	Cont Containment/H_2 Purge - Makeup Inlet	B'fly B'fly	CIS/A CIS/B	P P	M M	Closed Closed	Closed Closed	Closed Closed	Closed Closed	5 5	125V DC-SA 125V DC-SB
57	Cont Containment/H_2 Purge Exhaust	B'fly B'fly	CIS/A CIS/B	P P	M M	Closed Closed	Closed Closed	Closed Closed	Closed Closed	3 3	125V DC-SA 125V DC-SB
58	Cont Pressure	Globe	-	S	-	Open	Open	Open	Open	-	125V DC
59, 60	Shield Building Vent System (Does not penetrate containment)										
61	Spare										
62	HVAC Instr - (Does not penetrate containment)										
63	Spare										
64	Refer to Penetration 40										
65, 66	HVAC Instr - (Does not penetrate containment)										
67, 68	Containment Vacuum Relief	Check B'fly	- HDP	Self P	- M	Closed Closed	Closed Closed	Closed Closed	Closed Closed	- -	- 125V DC-SA/SB
69	Hot Leg Injection	Globe Check	- -	E Self	M -	LC -	Closed -	Closed -	FC -	- -	- -
70	Hot Leg Injection	Globe Check	- -	E Self	M -	LC -	Closed -	Closed -	FC -	- -	- -
71, 72	Containment Pressure (Inst)	Globe	-	S	-	Open	Open	Open	Open	-	125V DC

TABLE 6.2-53 (Cont'd)

Notes for Table 6.2-53

(1) CIAS - Containment Isolation Actuation Signal
SIAS - Safety Injection Actuation Signal
HDP - High Differential Pressure Between Containment Vessel and Annulus
RAS - Recirculation Actuation Signal
CSAS - Containment Spray Actuation Signal
MSIS - Main Steam Isolation Signal
AFAS - Auxiliary Feedwater Actuation Signal (Auto Initiation)

(2) E - Electric motor operated
P - Pneumatic cylinder or diaphragm or piston operated
S - Solenoid operated
M - Manually operated
Self - Actuated by the fluid pressure
H - Hydraulic cylinder operated

(3) FC - Fail closed
FO - Fail open
AI - As is
LC - Locked Close
LO - Locked Open
NA - Not Applicable

(4) Valves actuated on SIAS are listed on Table 7.3-2

(5) Valves actuated on RAS are listed on Table 7.3-3

(6) Valves actuated on a CSAS are listed on Table 7.3-4

(7) Valves actuated on a CIAS are listed on Table 7.3-5

(8) Valves actuated on a MSIS are listed on Table 7.3-6

TABLE 6.2-54

DESIGN AND PERFORMANCE DATA SPECIFIED FOR HYDROGEN ANALYZER SYSTEM

Analyzing Panel	
Approximate Dimensions;	
Height, inch	72
Width, inch	30
Depth, inch	30
Weight, lbm	750
Thermal Conductivity Analyzer:	
Sensitivity	0.2 percent H_2 by volume
Range	0-10 percent H_2 by volume
Accuracy	±5.0 percent of full scale
Calibration	Passing known gaseous mixture through analyzer
Control and Power Supply	
Electric Power Supply	115 Volt, 1 phase, 60 Hz and 460 Volt, 3 phase, 60 Hz
Control valves (solenoids)	Sample points in the containment
Tubing (External to Analyzer Package)	
Size	3/8" OD x .065 in
Material	ASME-SA-213 Type 316 GR
Design Temperature °F	340
Design Pressure psig	60
Code	ASME SECTION III, 1974 Edition,
Valves (Containment Sampling Isol. Valves FSE-27-15, 16, 17, 18)	
Size	3/8"
Material	ASME SA-240 Type F316
Design Temperature°F	350

TABLE 6.2-54 (Cont'd)

Design Pressure, psig	150
Code	ASME Section III Class 2, 1974 Edition
<u>Pumps</u>	
Type	Diaphragm
Pump material	Type 316 SS
Required H.P.	1.0
Design Flowrate scfm	0.3
<u>Cooler</u>	
Type	Natural Convection
Design	40 foot coil of sample tubing
Temp., F in/out	300/175
Pressure	10 inches of mercury vacuum
Material	ASME-SA-213 Type 316
<u>Water Separator</u>	
Body Material	Type 304 SE
Design Pressure psig	psig 100
Design Temperature F	400

TABLE 6.2-55

DESIGN AND PERFORMANCE DATA FOR HYDROGEN RECOMBINER SYSTEMS

Recombiner Unit	
Approximate Dimensions:	
Height ft.	8.0
Width ft. (skid)	3.9
Depth ft. (skid)	4.6
Weight lb.	4500
Capacity scfm	100
Gas Temperatures: F	
Inlet	80 to 155
outlet of heater section	1150 to 1400
Exhaust, ΔT above ambient	Approximately 100
Materials:	
Outer structure	Type 300 SS
Inner structure	Inconel 600
Heater element sheath	Incoloy 800
Power:,kW	
Maximum	75
Nominal	50
Recombination %	99-100
Control and Power Supply	
Electric Power Supply	480 Volt, 3 phase, 60 Hz
Thermocouple leads	3 pair (Chromel-Alumel)

TABLE 6.2-56

DESIGN DATA AND MATERIALS FOR HYDROGEN PURGE SYSTEM

Fan Section	
Quantity	2
Fan Performance, each	
H_2 Purging Capacity, cfm	100
Type	Centrifugal Fan, direct-driven with radial blades
Material	Carbon Steel
Bearings	131,000 hour B-10 rating life
Code	AWS D1.1, AMCA 210
Motor	
Quantity	One per fan
Type	Horizontal squirrel cage motor, totally enclosed fan cooled
Electrical Characteristics	480v, 3ph, 60Hz
Rating Hp	40
Insulation	Type H
Bearings	AF
Finish	Epoxy
Connections	Burndy connectors, grounding pad
Filter Train	
Demister Cells	2; 99% efficiency for 1 to 5 micron water particle size; 2.0 in. wg. max pressure drop, fiber-glass pads in stainless steel casing.
Electric Heater	12 kW; 480V/3ph/60Hz
Medium Efficiency Filters	2; 90% efficiency per ASHRAE 52 test; glass fiber media in galvanized frame; 1.0 in. wg. max. pressure drop
High Efficiency Filters	90-95% efficiency per ASHRAE 52-76 test

TABLE 6.2-56 (Cont'd)

HEPA Fitters	4: 2 Pre-HEPA, 2 After HEPA: 99.97% efficiency when tested with 0.3 micron DOP; 3.0 in. wg. max pressure drop; pleated glass paper enclosed in stain less steel frame
Charcoal Absorbers	99% efficiency in accordance with ANSI N509-1976; 1.37 in. wg. max pressure drop; activated coconut shell charcoal in stainless steel enclosure.
V-Bank Carbon Adsorber Cells	>99.9% efficiency in accordance with AACC-CS-8 (ANSI N509-1980)

TABLE 6.2-57

COMBUSTIBLE GAS CONTROL SYSTEM-FAILURE MODES AND EFFECTS ANALYSIS

Component Identification and Quantity	Failure Mode	Effects of System	Method of Detection	Monitor	Remarks
One Diesel	Fails	Loss of one train H_2 analyzer, one recombiner	Indication of the Diesel Generator voltage, and/or current.	CRI	Redundant diesel available redundant train of analyzer and recombiner available.
One Hydrogen Recombiner	Fails to operate	Loss of one H_2 recombiner	Low Power from heating coils, High H_2 alarm.	CRI*	Second recombiner available
One Hydrogen Analyzer	Fails internally	Loss of use of one H_2 analyzer; other analyzer available.	Low flow or sudden change on recorder	CRI	Use of redundant H_2 analyzer or Grab Samples.
One valve failure (normally open post accident; solenoid valves to and from analyzer) I-FSE-27-15, 16, 17 or 18	Fails closed and will not open	Loss of use of one analyzer	Low flow	CRI	Use of redundant H_2 analyzer or Grab Samples.
One Catalytic recombiner in analyzer panel	Poisoned	Temporary loss of use of one H_2 analyzer	Calibration gas (4% H_2) will read 0% H_2	CRI	Replacement of catalyst; use redundant H_2 analyzer or Grab Samples.
Containment isolation valve I-FSE-27-15 or 18	Valve fail to open	Loss of up to 4 sample points	Position indication	CRI	Three sample points remain, giving adequate sample points.
One sampling pump	Fails	Loss of use of one analyzer	Low flow	CRI	Use of redundant H_2 analyzer

* Control Room Indication

TABLE 6.2-58

PARAMETERS FOR ANALYSIS OF HYDROGEN GENERATION AND CONTROL

Hydrogen Dissolved in Reactor Coolant	423 SCF
Release Rate for Dissolved Hydrogen	Instantaneous
Amount of Zircaloy in core	48019 lbm
Fraction of Zirconium Oxidized During Design Basis Accident	1% (maximum)
Fraction of Zirconium Assumed to Oxidize for Purposes of Hydrogen Generation Analysis	5%
Release Rate from Zirconium-Water Reaction	Instantaneous
Fission Product Distribution Model	50% of the halogens and 1% of the solids present in the core are intimately mixed with the coolant water. All noble gases are released to the containment. All other fission products remain in fuel rods.
Fraction of Fission Product Radiation Energy Absorbed by the Coolant	(a) Beta (1) Betas from fission products in the fuel rods: 0.0 (2) Betas from fission products intimately mixed with coolant:1.0 (b) Gamma (1) Gammas from fission products in the fuel rods, coolant in core region: 0.1

TABLE 6.2-58 (Cont'd)

	(2) Gammas from fission products intimately mixed with coolant, all coolant: 1.0
Hydrogen Yield Rate $G(H_2)$	0.5 molecule per 100 Ev
Oxygen Yield Rate $G(O_2)$	0.25 molecule per 100 Ev
Reactor Thermal Power, mwt	2700
Inventory of Corrosible Metal	Table 6.2-59
Assumed Aluminum Corrosion Rate	Figure 6.2-65
Assumed Zinc Corrosion Rate	Figure 6.2-66
Assumed Hydrogen Generation Rate Due to Zinc-Base Paint	Figure 6.2-67
Containment Net Free Volume, ft^3	2,500,000
Initial Containment Temperature, F	120
Initial Containment Pressure, psia	14.7

TABLE 6.2-59

INVENTORY OF CORROSIBLE MATERIALS

I. Aluminum:

1. Overhead Cranes	125.5 lbm (reacts instantaneously)
2. Stair Treads	5342 lbm (1703 ft^2)
3. Transmitters	32 lbm (9 ft^2)
4. NSSS Equipment	59 lbm (17 ft^2)
5. Containment Piping Penetration Insulation Lagging	265 lbm (843 ft^2)
6. Cable Shielding	141 lbm (10,681 ft^2)
7. Boxes	100 lbm (5.2 ft^2)
8. Excore Nuclear Instrumentation	229.8 lbm (128.5 ft^2)
9. Ladders	75.0 lbm (232 ft^2)
10. Excore Dust Covers and	175 lbm (13.02 ft^2)
Clamps	3 lbm (2.0 ft^2)
Total Aluminum	6422.0 lbm (13,634 ft^2)

II. Zinc:

1. Galvanized Steel:	Ductwork, conduits, cable trays, tube supports/hangers, instrument racks, platforms and polar cranes

a. 41,417 ft^2 at 0.8 mils

b. 50,926 ft^2 at 1.53 mils

c. 91,047 ft^2 at 3.0 mils

d. 8,625 ft^2 at .0034 mils

e. 852 ft^2 at .0034 mils

f. 43,054 ft^2 at 3.91 mils

g. 4,720 ft^2 at 3.4 mils

TABLE 6.2-59 (Cont'd)

h. 10 ft^2 at 2.0 mils	
i. 3,835 ft^2 at 4.62 mils	
j. 3760 ft^2 at 4.2 mils	EC282639
Total galvanized steel:	30,823 lbm (248,319 ft^2)
2. Speltering	1600 lbm (10 ft^2)
III - Zinc - Base Paint	
Total Area	
	245,443 ft^2 (see revised Table 6.1-2)

TABLE 6.2-60

COMBUSTIBLE GAS CONTROL SYSTEM INSTRUMENTATION

System Parameter and Location	Indication Local	Indication Control Room	Alarm [a] Local	Alarm [a] Control Room	(a) Recording	Inst.[c] Range	Normal Operation Range	Inst.[c] Accuracy
Hydrogen Recombiner								
1) Power to recombiner		*					50-75 KW	
2) Coil temperature		*					1150-1400 F	
Containment Hydrogen Analyzers								
1) Sample hydrogen	*	*		Hi	*		--	
2) Containment isolation valve position indication		*				--	--	--
3) Containment hydrogen analyzer system failure				Failure		--	--	--

TABLE 6.2-60 (Cont'd)

System Parameter and Location	Indication Local	Indication Control Room	Alarm [a] Local	Alarm [a] Control Room	Recording [a]	Inst.[c] Range	Normal Operation Range	Inst.[c] Accuracy
Hydrogen Purge System		*					0-2000 cfm	
1) Flow rate [b]		*		*	*		0-100 cfm	
		*					0-2500 cfm	
2) Containment isolation valves position indication		*				--	--	--
3) SBVS/Purge isolation valves position indication		*				--	--	--
4) Modulating valves position indication		*					--	--
5) Makeup air containment isolation valves position indication		*				--	--	--
6) Continuous containment Purge/H_2 Purge air clean-up unit								
a) Demister differential pressure	*						1-3 in. wg.	
b) Inlet air temperature	*						60-270 F	
c) Air temperature after demister	*						60-270 F	

TABLE 6.2-60 (Cont'd)

System Parameter & Location			Indication Local	Indication Control Room	Alarm [a] Local	Alarm [a] Control Room	[a] Recording	Instrument[c] Range	Normal Operation Range	Instrument[c] Accuracy
Hydrogen Purge System (Cont'd)										
6)	d)	Electric heater diff. pressure	*						0-0.30 in. wg	
	e)	Air temperature downstream of electric heater					*		0-270 F	
	f)	Pre HEPA differen-tial pressure	*	*		Hi	*		1-3 in. wg 1-3 in. wg	
	g)	Relative humidity after pre HEPA filter	*			Hi			0-100%	
	h)	Charcoal Adsorber temperature					*		0-270 F	
	i)	Charcoal Adsorber diff. pressure	*				*		1-1.15 in. wg 1-1.15 in. wg	
	j)	Air temperature after charcoal adsorber	*				*		0-270 °F 0-270 °F	
	k)	After HEPA filter diff. pressure	*				*		1-3 in. wg 1-3 in. wg	
	l)	Filter train dif-ferential pressure					*		1-10 in. wg	

(a) All alarms and recordings are in the control room unless otherwise indicated.

(b) Alarm on 0 flow -10 second time delay.

(c) Instrument ranges are selected in accordance with standard engineering practices. Instrument accuracies are selected such that existing instrument loop performance and safety analysis assumptions remain valid. Where applicable, instrument accuracies are also evaluated for their impact on setpoints in accordance with the FPL Setpoint Methodology.

TABLE 6.2-61

This table has been deleted.

TABLE 6.2-62

CONTAINMENT ISOLATION VALVE TESTING*

Penetration No.	Isolation Valve Tag No.	Applicable Test: Type C	Applicable Test: Bypass Leakage	Drawing Reference
7	V15328 (inside)	X	X	2998-G-084,Sh 1
	HCV-15-1 (outside)	X	X	
8	V181270 (inside)	X	X	2998-085, Sh 1
	HCV-18-2 (outside)	X	X	
9	V18195 (inside)	X	X	2998-G-085, Sh 2A
	HCV-18-1 (outside)	X	X	
10	FCV-25-4 (inside)	X	-	2998-G-878
	FCV-25-5 (outside)	X	-	

TABLE 6.2-62 (Cont'd)

Penetration No.	Isolation Valve Tag No.	Applicable Test: Type C	Applicable Test: Bypass Leakage	Drawing Reference
11	FCV-25-3 (inside)	X	-	2998-G-878
	FCV-25-2 (outside)	X	-	
14	V6792 (inside)	X	X	2998-G-087, Sh 163B
	V6741 (outside)	X	X	
23	HCV-14-1 (inside)	X	X	2998-G-083, Sh 2
	HCV-14-7 (outside)	X	X	
24	HCV-14-2 (inside)	X	X	2998-G-083, Sh 2
	HCV-14-6 (outside)	X	X	
26	V2516 (inside)	X	x	2998-G-078, Sh 120 & 122

TABLE 6.2-62 (Cont'd)

Penetration No.	Isolation Valve Tag No.	Applicable Test Type C	Applicable Test Bypass Leakage	Drawing Reference
	V2522 (outside)	x	x	
28A	SE-05-1A, 1B,1C,1D (inside)	x	x	2998-G-078, Sh 153
	SE-05-1E (outside)	x	x	
28B	V5200 (inside)	x	x	2998-G-078, Sh 153
	V5203 (outside)			
29A	V5201 (inside)	x	x	2998-G-078, Sh 153
	V5204 (outside)			
29B	V5202 (inside)	x	x	2998-G-078, Sh 153

TABLE 6.2-62 (Cont'd)

Penetration No.	Isolation Valve Tag No.	Applicable Test Type C	Applicable Test Bypass Leakage	Drawing Reference
	V5205 (outside)	x	x	
31	V6718 (inside)	x	x	2998-G-078, Sh 163A
	V6750 (outside)	x	x	
41	SE-03-2B SE-03-2A (inside)	x	x	2998-G-078, Sh 130B
	V3463 (outside)	x	x	
42	LCV-07-11A (inside)	x	x	2998-G-088, Sh 2
	LCV-07-11B (outside)	x	x	
43	V6341 (inside)	x	x	2998-G-078, Sh 160A

TABLE 6.2-62 (Cont'd)

Penetration No.	Isolation Valve Tag No.	Applicable Test Type C	Applicable Test Bypass Leakage	Drawing Reference
	V6342 (outside)	x	x	
44	V2524 (inside)	x	x	2998-G-078, Sh 121A
	V2505 (outside)	x	x	
46	V07189 (inside)	x	x	2998-G-088, Sh 2
	V07206 (outside)	x	x	
47	V07188 (inside)	x	x	2998-G-088, Sh 2
	V07170 (outside)	x	x	

TABLE 6.2-62 (Cont'd)

Penetration No.	Isolation Valve Tag No.	Applicable Test Type C	Applicable Test Bypass Leakage	*Drawing Reference*
48A	FSE-27-8 through FSE-27-11 (inside)	x	-	2998-G-092, Sh 1
	FSE-27-15 (outside)	x	-	
48B	V27101 (inside)	x	-	2998-G-092, Sh 1
	FSE-27-16 (outside)	x	-	
51A	FSE-27-12 through FSE-27-14 (inside)	x	-	2998-G-092, Sh 1
	FSE-27-18 (outside)	x	-	

TABLE 6.2-62 (Cont'd)

Penetration No.	Isolation Valve Tag. No.	Applicable Test Type C	Applicable Test Bypass Leakage	Drawing Reference
51B	V27102 (inside)	x	-	2998-G-092, Sh 1
	FSE-27-17 (outside)	x	-	
52A,B	FCV-26-1,3 (inside)	x	x	2998-G-092, Sh 1
	FCV-26-2,4 (outside)	x	x	
52C	FCV-26-5 (inside)	x	x	2998-G-092, Sh 1
	FCV-26-6 (outside)	x	x	
52E	V00139 (inside)	x	x	2998-G-091, Sh 1

TABLE 6.2-62 (Cont'd)

Penetration No.	Isolation Valve Tag. No.	Applicable Type C	Test Bypass Leakage	Drawing Reference
	V00144 (outside)	x	x	
52D	V00140 (inside)	x	x	2998-G-091, Sh 1
	V00143 (outside)	x	x	
54	V00101 (outside)	x	x	2998-G-091, Sh 1
56	FCV-25-36 (inside)	x	x	2998-G-879, Sh 3
	FCV-25-26 (outside)	x	x	
57	FCV-25-20 (inside)	x	x	2998-G-879, Sh 3
	FCV-25-21 (outside)	x	x	

TABLE 6.2-62 (Cont'd)

Penetration No.	Isolation Valve Tag. No.	Applicable Type C	Test Bypass Leakage	Drawing Reference
67	V-25-20 (inside)	x	-	2998-G-878
	FCV-25-7 (outside)	x	-	
68	V-25-21 (inside)	x	-	2998-G-878
	FCV-25-8 (outside)	x	-	

* Refer to the Containment Leakage Rate Testing Program (10 CFR 50 Appendix J and/or Appendix J, Option B)

TABLE 6.2-63A

POSTULATED ACCIDENTS FOR CONTAINMENT DESIGN (STRETCH POWER), HISTORICAL

Containment Design Parameter	Postulated Accidents	Mass and Energy Release Data
Containment Peak Pressure/Temperature	Limiting Updated Loss of Coolant Accidents (LOCA)*	
	Double ended suction leg slot, 9.82 ft^2 area (minimum SI)	*
	Main Steam Line Breaks (MSLB)	
	7.6257 ft^2 MSLB, 102% power containment cooling train failure, increased core inlet temperature, decreased RCS flow rate	Table 6.2-67A (Deleted)
	7.6257 ft^2 MSLB, 102% power containment cooling train failure, increased core inlet temperature	Table 6.2-67B (Historical)
	7.6257 ft^2 MSLB, 102% power containment cooling train failure, decreased RCS flow rate	Table 6.2-67C (Historical)
	7.6257 ft^2 MSLB, 102% power MSIV failure, increased core inlet temperature, decreased RCS flow rate	Table 6.2-67D (Historical)
	7.6257 ft^2 MSLB, 102% power MSIV failure, increased core inlet temperature	Table 6.2-67E (Deleted)
	7.6257 ft^2 MSLB, 102% power MSIV failure, decreased RCS flow rate	Table 6.2-67F (Deleted)

* See Ref. (27) for break spectrum analysis.

TABLE 6.2-63B

POSTULATED ACCIDENTS FOR CONTAINMENT DESIGN (EPU)

Containment Design Parameter	Postulated Accidents	Mass and Energy Release Data
Containment Peak Pressure/Temperature	Limiting Updated Loss of Coolant Accidents (LOCA)	
	Double ended hot leg slot, 19.24 ft^2 area (min. SI)	
	Main Steam Line Breaks (MSLB)	
	100.3% power MSLB with the failure of one Containment Cooling Train	
	75% power MSLB with the failure of one Containment Cooling Train	
	50% power MSLB with the failure of one Containment Cooling Train	
	25% power MSLB with the failure of one Containment Cooling Train	
	Limiting EPU Peak Pressure	Table 6.2-12F
	0% power MSLB with the failure of one Containment Cooling Train	
	100.3% power MSLB with the failure of a MFIV to close	
	75% power MSLB with the failure of a MFIV to close	
	50% power MSLB with the failure of a MFIV to close	
	25% power MSLB with the failure of a MFIV to close	
	0% power MSLB with the failure of a MFIV to close	
	100.3% power MSLB with the failure of a MSIV to close	
	75% power MSLB with the failure of MSIV to close	
	50% power MSLB with the failure of MSIV to close	
	25% power MSLB with the failure of MSIV to close	
	0% power MSLB with the failure of MSIV to close	
	100.3% power EQ-MSLB with the failure of a MSIV to close	Table 6.2-12G

Table 6.2-64
This table has been deleted.

TABLE 6.2-65

VALVE CLOSURE TIMES AND ASSUMPTIONS USED IN MSLB ANALYSIS

EPU

Valve Closure Times (from receipt of signal)

1.	MSIV (I-HCV-08-1A and 1-HCV-08-1B) closure time, sec	5.6
2.	MFIV (1-HCV-09-1A and I-HCV-09-2A) closure time, sec	4.0
3.	Backup feedwater isolation valve (I-HCV-09-1B, 2B) closure time, sec	4.0
4.	Reactor trip on low steam generator pressure psia	546 psia
5.	Reactor trip on high containment pressure, psig	6.4 psig
6.	Instrumentation delay time, sec	1.15

Assumptions

1. Credit is not taken for the coastdown of the main feedwater pumps or condensate pumps in the MSLB analysis. Therefore, no degradation of the feedwater flow occurs until the closure of the main feedwater isolation or backup valves.

2. Offsite power is assumed to be available for the analysis. Availability of offsite power allows the continuation of reactor coolant pump and feedwater pump flows. Maintaining reactor coolant and feedwater pump flow maximizes the rate of primary to secondary heat transfer which maximizes the rate of mass/energy release.

TABLE 6.2-66A

MASS/ENERGY RELEASE RATES FOR 1000 SQ IN
HOT LEG GUILL. BREAK AT SG NOZZLE
FOR SUBCOMPARTMENT ANALYSIS OF
ST LUCIE II STRETCH POWER (2700 MWT)
(FLOW FROM RCS SIDE)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE BTU/SEC)	B.N.PRESS (PSIA)	DENSITY (LB/CU.FT.
0.00000	0.0	615.40	0.	2256.0	43.0
.00100	6457.0	615.20	3972346.	2211.0	43.0
.00200	11980.0	614.60	7362908.	2067.0	42.8
.00300	15720.0	613.70	9647364.	1857.0	42.8
.00400	18230.0	612.80	11171344.	1652.0	42.7
.00500	20050.0	612.20	12274610.	1506.0	42.6
.00600	24040.0	612.20	14717288.	1505.0	42.5
.00700	28020.0	612.20	17153844.	1504.0	42.4
.00800	31980.0	612.20	19578156.	1503.0	42.3
.00900	35920.0	612.20	21990224.	1502.0	42.2
.01000	39830.0	612.20	24383926.	1501.0	42.1
.01200	39690.0	612.30	24302187.	1498.0	41.8
.01400	39570.0	612.30	24228711.	1496.0	41.6
.01600	39480.0	612.30	24173604.	1495.0	41.5
.01800	39400.0	612.30	24124620.	1494.0	41.3
.02000	39350.0	612.40	24097940.	1493.0	41.2
.02200	39320.0	612.40	24079568.	1493.0	41.2
.02400	39300.0	612.40	24067320.	1493.0	41.1
.02600	39300.0	612.50	24071250.	1493.0	41.1
.02800	39320.0	612.50	24083500.	1493.0	41.2
.03000	39350.0	612.50	24101875.	1494.0	41.2
.03200	39390.0	612.60	24130314.	1495.0	41.3
.03400	39450.0	612.60	24167070.	1496.0	41.4
.03600	39520.0	612.60	24209952.	1498.0	41.5
.03800	39610.0	612.70	24269047.	1499.0	41.6
.04000	39700.0	612.70	24324190.	1501.0	41.8
.04200	39800.0	612.70	24385460.	1503.0	41.9
.04400	39920.0	612.70	24458984.	1505.0	42.1
.04600	40030.0	612.80	24530384.	1508.0	42.3
.04800	40130.0	612.80	24591664.	1510.0	42.5
.05000	46440.0	613.50	28490940.	1686.0	42.7
.05500	41240.0	612.90	25275996.	1537.0	42.6
.06000	40120.0	612.70	24581524.	1509.0	42.5
.06500	40100.0	612.70	24569270.	1509.0	42.5
.07000	40070.0	612.60	24546882.	1507.0	42.4
.07500	39980.0	612.60	24491748.	1506.0	42.3
.08000	39820.0	612.50	24389750.	1503.0	42.0
.08500	39590.0	612.50	24248875.	1498.0	41.6
.09000	39280.0	612.40	24055072.	1492.0	41.1
.09500	38930.0	612.40	23840732.	1486.0	40.6
.10000	38550.0	612.30	23604165.	1479.0	40.0
.11000	37800.0	612.20	23141160.	1464.0	38.8
.12000	37100.0	612.10	22708910.	1451.0	37.8
.13000	36510.0	612.00	22344120.	1440.0	36.9
.14000	36080.0	612.00	22080960.	1432.0	36.3

TABLE 6.2-66A (CONT'D)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE BTU/SEC)	B.N.PRESS (PSIA)	DENSITY (LB/CU.FT.)
.15000	35880.0	612.00	21958560.	1428.0	36.0
.16000	35900.0	612.00	21970800.	1429.0	36.0
.17000	36050.0	612.00	22062600.	1431.0	36.2
.18000	36230.0	612.00	22172760.	1435.0	36.5
.19000	36350.0	612.00	22246200.	1437.0	36.7
.20000	36380.0	612.00	22264560.	1438.0	36.7
.22000	36150.0	612.00	22123800.	1433.0	36.4
.24000	35490.0	612.00	21719880.	1422.0	35.5
.26000	34570.0	611.90	21153383.	1405.0	34.3
.28000	33660.0	611.90	20584316.	1390.0	33.2
.30000	33060.0	612.00	20232720.	1381.0	32.5
.32000	32960.0	612.10	20174516.	1380.0	32.4
.34000	33040.0	612.20	20227088.	1382.0	32.5
.36000	32940.0	612.20	20165863.	1380.0	32.4
.38000	32550.0	612.30	19930365.	1375.0	31.9
.40000	32010.0	612.30	19599723.	1367.0	31.4
.42000	31550.0	612.40	19321220.	1361.0	30.9
.44000	31290.0	612.50	19165125.	1357.0	30.7
.46000	31140.0	612.60	19076364.	1356.0	30.5
.48000	30960.0	612.70	18969192.	1353.0	30.3
.50000	30650.0	612.80	18782320.	1349.0	30.0
.55000	29750.0	612.90	18233775.	1337.0	29.2
.60000	29080.0	613.20	17831856.	1329.0	28.6
.65000	28520.0	613.60	17499872.	1320.0	27.9
.70000	28330.0	614.10	17397453.	1309.0	27.1
.75000	28150.0	614.50	17298175.	1299.0	26.4
.80000	27950.0	615.00	17189250.	1289.0	25.7
.85000	27740.0	615.30	17068422.	1277.0	25.0
.90000	27510.0	615.60	16935156.	1266.0	24.4
.95000	27280.0	615.80	16799024.	1256.0	23.7
1.00000	27070.0	616.20	16680534.	1244.0	23.1
1.10000	26730.0	617.20	16497756.	1231.0	22.3
1.20000	26330.0	618.30	16279839.	1215.0	21.4
1.30000	25920.0	618.80	16039296.	1198.0	20.6
1.40000	25490.0	619.00	15778310.	1182.0	19.5
1.50000	25050.0	619.20	15510960.	1165.0	19.2
1.60000	24650.0	619.70	15275605.	1151.0	18.5
1.70000	24360.0	620.20	15108072.	1140.0	18.1
1.80000	24030.0	620.40	14908212.	1127.0	17.6
1.90000	23680.0	620.30	14688704.	1112.0	17.1
2.00000	23390.0	620.40	14511156.	1099.0	16.7
2.10000	23140.0	620.70	14362998.	1088.0	16.3
2.20000	22870.0	621.00	14202270.	1075.0	15.8
2.30000	22670.0	621.20	14082604.	1066.0	15.5
2.40000	22470.0	621.20	13958364.	1056.0	15.2

TABLE 6.2-66A (CONT'D)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE BTU/SEC)	B.N.PRESS (PSIA)	DENSITY (LB/CU.FT.)
2.50000	22260.0	621.40	13832364.	1046.0	14.9
2.60000	22070.0	621.60	13718712.	1036.0	14.6
2.70000	21890.0	621.70	13609013.	1028.0	14.4
2.80000	21730.0	621.80	13511714.	1020.0	14.2
2.90000	21620.0	621.80	13443316.	1014.0	14.0
3.00000	21550.0	621.50	13393325.	1010.0	13.9
3.50000	21200.0	618.70	13116440.	983.4	13.5
4.00000	20910.0	615.10	12861741.	958.7	13.3

TABLE 6.2-66B

MASS/ENERGY RELEASE RATES FOR 1000 SQ IN
HOT LEG GUILL. BREAK AT SG NOZZLE
FOR SUBCOMPARTMENT ANALYSIS OF
ST LUCIE II STRETCH POWER (2700 MWT)
(FLOW FROM SG SIDE)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE BTU/SEC)	B.N.PRESS (PSIA)	DENSITY (LB/CU.FT.)
0.00000	0.0	615.40	0.	2255.0	43.0
.00100	6072.0	614.70	3732458.	2091.0	42.9
.00200	11360.0	614.20	6977312.	1977.0	42.9
.00300	17170.0	614.30	10547531.	1990.0	42.9
.00400	20790.0	613.70	12758823.	1846.0	42.8
.00500	23080.0	612.90	14145732.	1670.0	42.7
.00600	25990.0	612.50	15918875.	1590.0	42.6
.00700	28930.0	612.30	17713839.	1537.0	42.6
.00800	32070.0	612.20	19633254.	1505.0	42.6
.00900	35990.0	612.20	22033078.	1503.0	42.4
.01000	39790.0	612.10	24355459.	1499.0	42.0
.01200	39320.0	612.10	24067772.	1491.0	41.3
.01400	38920.0	612.10	23822932.	1484.0	40.6
.01600	38600.0	612.10	23627060.	1478.0	40.1
.01800	38370.0	612.10	23486277.	1473.0	39.7
.02000	38240.0	612.10	23406704.	1471.0	39.5
.02200	38210.0	612.10	23388341.	1470.0	39.4
.02400	38260.0	612.10	23418946.	1471.0	39.5
.02600	38390.0	612.10	23498519.	1474.0	39.7
.02800	38560.0	612.10	23602576.	1477.0	40.0
.03000	38760.0	612.20	23728872.	1481.0	40.3
.03200	38960.0	612.20	23851312.	1485.0	40.6
.03400	39140.0	612.20	23961508.	1488.0	40.9
.03600	39290.0	612.20	24053338.	1491.0	41.2
.03800	39400.0	612.20	24120680.	1493.0	41.3
.04000	39460.0	612.20	24157412.	1494.0	41.4
.04200	39470.0	612.30	24167481.	1494.0	41.5
.04400	39440.0	612.30	24149112.	1494.0	41.4
.04600	39360.0	612.30	24100128.	1492.0	41.3
.04800	39240.0	612.30	24026652.	1490.0	41.1
.05000	39150.0	613.30	23971545.	1489.0	40.9
.05500	39790.0	612.40	24367396.	1501.0	41.9
.06000	40300.0	612.50	24683750.	1511.0	42.6
.06500	39730.0	612.50	24334625.	1501.0	41.9
.07000	38800.0	612.40	23761120.	1484.0	40.4
.07500	37780.0	612.40	23136472.	1465.0	38.8
.08000	37080.0	612.40	22707792.	1452.0	37.7
.08500	36880.0	612.40	22585312.	1449.0	37.4
.09000	37050.0	612.40	22689420.	1452.0	37.6
.09500	37310.0	612.40	22848644.	1457.0	38.0
.10000	37480.0	612.40	22952752.	1460.0	38.3
.11000	37290.0	612.30	22832667.	1456.0	38.0
.12000	36780.0	612.20	22516716.	1446.0	37.3
.13000	36560.0	612.20	22382032.	1442.0	37.0
.14000	36610.0	612.10	22408981.	1442.0	37.0

TABLE 6.2-66B (CONT'D)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)	B.N.PRESS (PSIA)	DENSITY (LB/CU.FT.)
.15000	36580.0	612.10	22390618	1441.0	37.0
.16000	36330.0	612.00	22233960.	1437.0	36.7
.17000	35970.0	612.00	22013640.	1430.0	36.2
.18000	35630.0	612.00	21805560.	1424.0	35.7
.19000	35510.0	612.00	21732120.	1421.0	35.5
.20000	35460.0	612.00	21713760.	1421.0	35.5
.22000	35010.0	612.00	21426120.	1413.0	34.9
.24000	34370.0	611.90	21031003.	1401.0	34.0
.26000	33630.0	611.90	20578197.	1389.0	33.2
.28000	33110.0	611.90	20260009.	1381.0	32.6
.30000	32900.0	611.90	20131510.	1378.0	32.4
.32000	32570.0	612.00	19932840.	1373.0	32.0
.34000	32210.0	612.00	19712520.	1368.0	31.6
.36000	31790.0	612.10	19458659.	1362.0	31.2
.38000	31440.0	612.20	19247568.	1358.0	30.8
.40000	31170.0	612.20	19082274.	1354.0	30.6
.42000	30920.0	612.30	18932316.	1351.0	30.3
.44000	30660.0	612.40	18776184.	1347.0	30.1
.46000	30360.0	612.50	18595500.	1343.0	29.8
.48000	30040.0	612.60	18402504.	1339.0	29.5
.50000	29700.0	612.60	18194220.	1335.0	29.2
.55000	29000.0	612.80	17771200.	1326.0	28.6
.60000	28510.0	613.10	17479481.	1317.0	27.9
.65000	28360.0	613.40	17396024.	1307.0	27.3
.70000	28170.0	613.90	17293563.	1297.0	26.5
.75000	27970.0	614.30	17181971.	1287.0	25.8
.80000	27760.0	614.80	17066848.	1276.0	25.1
.85000	27540.0	615.10	16939854.	1265.0	24.5
.90000	27310.0	615.40	16806574.	1253.0	23.8
.95000	27070.0	615.70	16666999.	1241.0	23.2
1.00000	26850.0	616.00	16539600.	1231.0	22.7
1.10000	26500.0	617.00	16350500.	1218.0	21.8
1.20000	26070.0	618.10	16113867.	1201.0	20.9
1.30000	25600.0	618.70	15838720.	1185.0	20.1
1.40000	25180.0	619.00	15586420.	1170.0	19.4
1.50000	24740.0	619.10	15316534.	1153.0	18.7
1.60000	24340.0	619.60	15081064.	1138.0	18.1
1.70000	24070.0	620.10	14925807.	1128.0	17.7
1.80000	23750.0	620.30	14732125.	1115.0	17.2
1.90000	23410.0	620.30	14521223.	1100.0	16.7
2.00000	23150.0	620.40	14362260.	1087.0	16.3
2.10000	22890.0	620.70	14207823.	1075.0	15.9
2.20000	22630.0	621.90	14050967.	1063.0	15.5
2.30000	22440.0	621.10	13937484.	1054.0	15.2
2.40000	22250.0	62110	13119475.	1044.0	14.9

TABLE 6.2-66B (CONT'D)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)	B.N.PRESS (PSIA)	DENSITY (LB/CU.FT.)
2.50000	22040.0	621.20	13691248.	1034.0	14.6
2.60000	21840.0	621.40	13571376.	1024.0	14.3
2.70000	21660.0	621.50	13461690.	1016.0	14.1
2.80000	21500.0	621.70	13366550.	1008.0	13.8
2.90000	21390.0	621.60	13296024.	1002.0	13.7
3.00000	21350.0	621.30	13264755.	998.7	13.6
3.50000	21090.0	617.40	13020966.	974.0	13.4
4.00000	20850.0	612.90	12778965.	949.3	13.3

TABLE 6.2-66C

MASS/ENERGY RELEASE RATES FOR 1400 SQ IN
DISCHARGE LEG GUILL. BREAK AT PUMP NOZZLE
FOR SUBCOMPARTMENT ANALYSIS OF
ST LUCIE II STRETCH POWER (2700 MWT)
(FLOW FROM PUMP SIDE)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)	B.N.PRESS (PSIA)	DENSITY (LB/CU.FT.)
0.00000	0.0	547.90	0.	2291.0	46.8
.00100	10580.0	546.90	5786202.	2042.0	46.7
.00200	15700.0	544.80	8553360.	1506.0	46.5
.00300	15160.0	542.90	8230364.	1041.0	46.3
.00400	19120.0	542.80	10378336.	1002.0	46.2
.00500	23860.0	542.80	12951208.	1001.0	46.0
.00600	28550.0	542.80	15486940.	999.9	45.7
.00700	33180.0	542.90	18013422.	998.6	45.4
.00800	37730.0	542.90	20483617.	996.8	45.0
.00900	42200.0	542.90	22910380.	994.7	44.5
.01000	46550.0	542.90	25271995.	992.1	44.0
.01200	45890.0	542.90	24913681.	987.1	43.0
.01400	45250.0	542.90	24566225.	982.1	42.0
.01600	44600.0	542.90	24213340.	977.0	41.1
.01800	43940.0	542.90	23855026.	971.9	40.2
.02000	43260.0	542.90	23485854.	966.8	39.3
.02200	42600.0	543.00	23131800.	961.0	38.4
.02400	41940.0	543.00	22773420.	957.0	37.6
.02600	41300.0	543.00	22425900.	952.4	36.9
.02800	40700.0	543.10	22104170.	948.2	36.2
.03000	40120.0	543.20	21793184.	944.2	35.5
.03200	39580.0	543.20	21499856.	940.6	35.0
.03400	39060.0	543.30	21221298.	937.1	34.4
.03600	38560.0	543.40	20953504.	933.8	33.9
.03800	38060.0	543.40	20681604.	930.5	33.4
.04000	37570.0	543.40	20415538.	927.1	33.0
.04200	37070.0	543.50	20147543.	923.8	32.5
.04400	36560.0	543.50	19870360.	920.4	32.1
.04600	36150.0	543.50	19647525.	916.9	31.6
.04800	36060.0	543.60	19602216.	913.3	31.2
.05000	35950.0	543.60	19542420.	909.7	30.7
.05500	35690.0	543.70	19404653.	900.6	29.7
.06000	35360.0	543.80	19228768.	892.0	28.7
.06500	35010.0	543.90	19041939.	883.7	27.7
.07000	34580.0	544.00	18811520.	785.1	26.9
.07500	34030.0	544.00	18512320.	865.5	26.0
.08000	33260.0	544.00	18093440.	854.9	25.0
.08500	32530.0	544.00	17696320.	843.8	24.1
.09000	32150.0	544.00	17489600.	832.8	23.2
.09500	31750.0	544.00	17272000.	821.6	22.4
.10000	31320.0	543.90	17034948.	809.8	21.5
.11000	30230.0	543.70	16436051.	784.7	19.8
.12000	29310.0	543.70	15935847.	759.8	18.1
.13000	28520.0	543.70	11506324.	739.0	16.8
.14000	27840.0	543.80	15139392.	721.9	15.9

TABLE 6.2-66C (CONT'D)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)	B.N.PRESS (PSIA)	DENSITY (LB/CU.FT.)
.15000	27280.0	543.90	14837592.	708.2	15.1
.16000	26910.0	544.10	14641731.	698.9	14.6
.17000	26670.0	544.20	14513814.	693.3	14.3
.18000	26390.0	544.30	14364077.	687.0	14.0
.19000	26100.0	544.40	14208840.	680.1	13.7
.20000	25850.0	544.50	14075325.	674.4	13.4
.22000	25470.0	544.60	13870962.	665.6	13.0
.24000	25280.0	544.80	13772544.	661.4	12.8
.26000	25180.0	545.00	13723100.	659.5	12.7
.28000	24920.0	545.00	13581400.	653.8	12.5
.30000	24650.0	545.10	13436715.	647.7	12.2
.32000	24300.0	545.10	13245930.	639.8	11.9
.34000	24130.0	545.30	13158089.	635.6	11.7
.36000	23840.0	545.40	13002336.	629.9	11.5
.38000	23440.0	545.40	12784176.	620.9	11.2
.40000	23100.0	545.50	12601050.	613.2	10.9
.42000	22810.0	545.60	12445136.	606.9	10.7
.44000	22490.0	545.70	12272793.	599.1	10.4
.46000	22140.0	545.70	12081798.	589.9	10.0
.48000	21790.0	545.90	11895161.	581.2	9.7
.50000	21550.0	546.00	11766300.	575.7	9.5
.55000	20800.0	546.30	11417670.	560.8	9.0
.60000	20370.0	546.70	11136279.	549.8	8.6
.65000	20010.0	547.10	10947471.	542.9	8.4
.70000	19680.0	547.40	10772832.	536.8	8.2
.75000	19360.0	547.80	10605408.	530.9	8.0
.80000	19040.0	548.10	10435824.	525.3	7.8
.85000	18760.0	548.50	10289860.	520.5	7.7
.90000	18500.0	548.90	10154650.	516.2	7.5
.95000	18200.0	549.20	9995440.	511.3	7.4
1.00000	17890.0	549.60	9832344.	506.2	7.2
1.10000	17350.0	550.30	9547705.	497.8	7.0
1.20000	16890.0	551.00	9306390.	491.1	6.8
1.30000	16410.0	551.70	9053397.	482.9	6.5
1.40000	16000.0	552.40	8838400.	472.1	6.3
1.50000	15640.0	553.00	8648920.	462.7	6.0
1.60000	15380.0	553.70	8515906.	456.0	5.8
1.70000	15090.0	554.30	8364387.	448.6	5.7
1.80000	14870.0	554.80	8249876.	443.3	5.5
1.90000	14650.0	555.40	8136610.	438.0	5.4
2.00000	14420.0	555.90	8016078.	432.2	5.3
2.10000	14280.0	556.40	7945392.	429.0	5.2
2.20000	14100.0	556.80	7850880.	424.7	5.1
2.30000	14000.0	557.30	7802200.	422.5	5.1
2.40000	13850.0	557.70	7724145.	419.2	5.0

TABLE 6.2-66C (CONT'D)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE BTU/SEC)	B.N.PRESS (PSIA)	DENSITY (LB/CU.FT.)
2.50000	13940.0	556.30	7782702.	422.0	5.0
2.60000	14330.0	558.70	8006171.	433.5	5.2
2.70000	14560.0	559.10	8140496.	440.6	5.3
2.80000	14660.0	559.40	8200804.	443.8	5.4
2.90000	14740.0	559.80	8251452.	446.5	5.4
3.00000	14800.0	560.30	8292440.	448.6	5.4
3.50000	15360.0	563.40	8653824.	468.9	5.7
4.00000	15910.0	568.60	9046426.	492.1	5.9

TABLE 6.2-66D

MASS/ENERGY RELEASE RATES FOR 1400 SQ IN
DISCHARGE LEG GUILL. BREAK AT PUMP NOZZLE
FOR SUBCOMPARTMENT ANALYSIS OF
ST LUCIE II STRETCH POWER (2700 MWT)
(FLOW FROM PV SIDE)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)	B.N.PRESS (PSIA)	DENSITY (LB/CU.FT.)
0.00000	0.0	547.90	0.	2291.0	46.8
.00100	10990.0	547.30	6014827.	2144.0	46.8
.00200	17930.0	545.70	9784401.	1739.0	46.6
.00300	18220.0	545.50	9902570.	1197.0	46.4
.00400	19110.0	542.70	10370997.	1002.0	46.2
.00500	23850.0	542.70	12943395.	1000.0	46.0
.00600	28530.0	542.70	15483231.	999.1	45.7
.00700	33160.0	542.70	17995932.	997.7	45.4
.00800	37740.0	542.70	20481498.	996.1	45.0
.00900	42250.0	542.70	22929075.	994.2	44.7
.01000	46700.0	542.70	25344090.	992.2	44.3
.01200	46130.0	542.70	25034751.	987.8	43.4
.01400	45590.0	542.70	24741693.	983.5	42.6
.01600	45060.0	542.70	24454062.	979.3	41.8
.01800	44550.0	542.70	21477285.	975.3	41.1
.02000	44050.0	542.70	23805935.	971.5	40.4
.02200	43580.0	542.70	23650866.	967.9	39.7
.02400	43130.0	542.70	23406651.	964.5	39.2
.02600	42700.0	542.70	23173290.	961.3	38.6
.02800	42300.0	542.70	22956210.	958.4	38.1
.03000	41930.0	542.80	22759604.	955.7	37.7
.03200	41590.0	542.80	22575052.	953.3	37.1
.03400	41270.0	542.80	22401356.	951.1	36.9
.03600	40990.0	542.90	22253471.	949.2	36.5
.03800	40740.0	542.90	22117746.	947.5	36.2
.04000	40510.0	542.90	21992879.	946.1	36.0
.04200	40320.0	543.00	21893760.	944.8	35.8
.04400	40160.0	543.00	21806880.	944.0	35.6
.04600	40030.0	543.10	21740293.	943.3	35.5
.04800	39930.0	543.20	21689976.	942.8	35.3
.05000	39860.0	543.20	21651952.	942.5	35.2
.05500	39790.0	543.30	21617907.	942.7	35.2
.06000	39860.0	543.50	21663910.	943.9	35.2
.06500	40070.0	543.60	21782052.	946.0	35.4
.07000	40370.0	543.70	21949169.	948.7	35.7
.07500	40740.0	543.80	22154412.	951.8	36.1
.08000	41140.0	543.80	22371932.	955.0	36.5
.08500	41550.0	543.90	22599045.	958.2	37.0
.09000	41960.0	543.90	22822044.	961.3	37.5
.09500	42380.0	543.90	23050482.	964.6	37.9
.10000	42800.0	543.90	23278920.	968.0	38.4
.11000	43710.0	544.00	23778240.	975.3	39.6
.12000	44670.0	544.10	24304947.	983.2	40.8
.13000	45660.0	544.20	24848172.	991.3	42.2
.14000	46650.0	544.30	25391595.	999.4	43.7

TABLE 6.2-66D (CONT'D)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)	B.N.PRESS (PSIA)	DENSITY (LB/CU.FT.)
.15000	47650.0	544.40	25940660.	1009.0	45.3
.16000	65260.0	545.50	35599330.	1287.0	46.3
.17000	64560.0	545.30	35204568.	1274.0	46.3
.18000	63720.0	545.20	34740144.	1259.0	46.3
.19000	63030.0	545.00	34351350.	1247.0	46.3
.20000	62180.0	544.90	33881882.	1232.0	46.3
.22000	62170.0	544.80	33870216.	1232.0	46.3
.24000	62070.0	544.80	33815736.	1230.0	46.3
.26000	62060.0	544.80	33810288.	1230.0	46.3
.28000	61210.0	544.60	33334966.	1215.0	46.3
.30000	60860.0	544.60	33144356.	1209.0	46.3
.32000	60980.0	544.60	33209708.	1211.0	46.3
.34000	60920.0	544.60	33177032.	1210.0	46.3
.36000	60330.0	544.60	32855718.	1200.0	46.3
.38000	60050.0	544.60	32703230.	1196.0	46.3
.40000	60230.0	544.70	32807281.	1199.0	46.3
.42000	60160.0	544.70	32769152.	1198.0	46.3
.44000	59580.0	544.70	32453226.	1189.0	46.3
.46000	59120.0	544.70	32202664.	1182.0	46.3
.48000	59250.0	544.70	32273475.	1184.0	46.3
.50000	59240.	544.80	32273952.	1185.0	46.3
.55000	58380.0	544.90	31811262.	1172.0	46.3
.60000	58010.0	545.00	31615450.	1167.0	46.3
.65000	57670.0	545.20	31441684.	1163.0	46.3
.70000	56910.0	545.30	31033023.	1152.0	46.3
.75000	56510.0	545.50	30826205.	1147.0	46.2
.80000	56020.0	545.70	30570114.	1140.0	46.2
.85000	55490.0	545.90	30291991.	1133.0	46.2
.90000	55030.0	546.10	30051883.	1128.0	46.2
.95000	54580.0	546.40	29822512.	1122.0	46.2
1.00000	54160.0	546.70	29609272.	1117.0	46.2
1.10000	53350.0	547.20	29193120.	1108.0	46.1
1.20000	52440.0	547.80	28726632.	1097.0	46.1
1.30000	51440.0	548.50	28214840.	1085.0	46.0
1.40000	50920.0	549.20	27965264.	1080.0	46.0
1.50000	50330.0	549.90	27676467.	1075.0	46.0
1.60000	49700.0	550.60	27364820.	1069.0	45.9
1.70000	49000.0	551.20	27008800.	1061.0	45.9
1.80000	48840.0	551.80	26949912.	1062.0	45.5
1.90000	48200.0	552.30	26620560.	1059.0	44.3
2.00000	47340.0	552.80	26169552.	1054.0	42.9
2.10000	46470.0	552.30	25711851.	1049.0	41.6
2.20000	45680.0	553.70	25293016.	1044.0	40.4
2.30000	44970.0	554.10	24917877.	1040.0	39.4
2.40000	44310.0	554.40	24565464.	1036.0	38.5

TABLE 6.2-66D (CONT'D)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)	B.N.PRESS (PSIA)	DENSITY (LB/CU.FT.)
2.50000	43690.0	554.70	24234843.	1032.0	37.7
2.60000	43080.0	555.00	23909400.	1029.0	36.9
2.70000	42540.0	555.30	23572485.	1024.0	36.2
2.80000	41810.0	555.50	23225455.	1020.0	35.4
2.90000	41160.0	555.70	22872612.	1015.0	34.7
3.00000	40490.0	555.90	22508391.	1010.0	34.0
3.50000	37360.0	557.60	20831936.	992.4	30.9
4.00000	36130.0	559.10	20200283.	990.3	29.8

TABLE 6.2-66E

MASS/ENERGY RELEASE RATES FOR 1400 SQ IN
SUCTION LEG GUILL. BREAK AT PUMP NOZZLE
FOR SUBCOMPARTMENT ANALYSIS OF
ST LUCIE II STRETCH POWER (2700 MWT)
(FLOW FROM SG SIDE)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)	B.N.PRESS (PSIA)	DENSITY (LB/CU.FT.)
0.00000	0.0	547.90	0.	2241.0	46.8
.00100	10780.0	547.40	5900972.	2087.0	46.7
.00200	17850.0	546.00	9746100.	1730.0	46.6
.00300	18850.0	544.00	10254400.	1234.0	46.4
.00400	19180.0	543.10	10416658.	1004.0	46.2
.00500	23930.0	543.10	12996383.	1003.0	46.0
.00600	28670.0	543.10	15570677.	1002.0	45.7
.00700	33350.0	543.10	18112385.	1000.0	45.5
.00800	37980.0	543.10	20626938.	999.0	45.1
.00900	42560.0	543.10	23114336.	997.4	44.8
.01000	47090.0	543.10	25574579.	995.9	44.5
.01200	46780.0	543.10	25406218.	993.5	44.0
.01400	46490.0	543.20	25253368.	991.4	43.5
.01600	46230.0	543.20	25112136.	989.5	43.1
.01800	45980.0	543.20	24976336.	987.7	42.7
.02000	45750.0	543.20	24851400.	986.0	42.4
.02200	45540.0	543.30	24741882.	984.4	42.1
.02400	45340.0	543.30	24633222.	983.0	41.8
.02600	45160.0	543.30	24535428.	981.7	41.5
.02800	44990.0	543.30	24443067.	980.6	41.3
.03000	44840.0	543.40	24366056.	979.5	41.0
.03200	44700.0	543.40	24289980.	978.6	40.8
.03400	44570.0	543.40	24219338.	977.7	40.7
.03600	44450.0	543.40	24154130.	976.9	40.5
.03800	44350.0	543.50	24104225.	976.2	40.3
.04000	44260.0	543.50	24055310.	975.6	40.2
.04200	44180.0	543.50	24011830.	975.1	40.1
.04400	44100.0	543.50	23968350.	974.6	40.0
.04600	44040.0	543.50	23935740.	974.3	39.9
.04800	43990.0	543.60	23912964.	973.9	39.8
.05000	43940.0	543.60	23885784.	973.7	39.8
.05500	43860.0	543.60	23842296.	973.3	39.7
.06000	43820.0	543.70	23824934.	973.2	39.6
.06500	43810.0	543.70	23819497.	973.3	39.6
.07000	43830.0	543.70	23830371.	973.6	39.6
.07500	43870.0	543.80	23856506.	974.1	39.6
.08000	43940.0	543.80	23894572.	974.8	39.7
.08500	44030.0	543.90	23947971.	975.8	39.8
.09000	44150.0	543.90	24013185.	977.0	40.0
.09500	44310.0	544.00	24104640.	978.6	40.1
.10000	44500.0	544.10	24212450.	980.4	40.4
.11000	44970.0	544.30	24477171.	984.8	41.0
.12000	45520.0	544.40	24781088.	989.9	41.7
.13000	46150.0	544.60	25133290.	995.6	42.6
.14000	46770.0	544.70	25475619.	1002.0	43.6

TABLE 6.2-66E (CONT'D)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)	B.N.PRESS (PSIA)	DENSITY (LB/CU.FT.)
.15000	47410.0	544.90	25833709.	1008.0	44.5
.16000	48050.0	545.10	26192055.	1015.0	45.6
.17000	60830.0	546.00	33213180.	1214.0	46.3
.18000	61070.0	546.10	33350327.	1219.0	46.3
.19000	61380.0	546.30	33531894.	1225.0	46.3
.20000	61160.0	546.40	33417824.	1222.0	46.2
.22000	60500.0	546.60	33069300.	1212.0	46.2
.24000	60680.0	547.00	33191960.	1217.0	46.2
.26000	61170.0	547.40	33484458.	1227.0	46.2
.28000	60260.0	547.70	33004402.	1214.0	46.2
.30000	59850.0	548.10	32803785.	1209.0	46.1
.32000	59550.0	548.50	32663175.	1206.0	46.1
.34000	59770.0	549.00	32813730.	1212.0	46.1
.36000	59050.0	549.30	32436165.	1202.0	46.1
.38000	58870.0	549.80	32366726.	1202.0	46.0
.40000	58700.0	550.30	32302610.	1202.0	46.0
.42000	58290.0	550.70	32100303.	1197.0	46.0
.44000	58030.0	551.20	31986136.	1196.0	46.0
.46000	57410.0	551.60	31667356.	1188.0	45.9
.48000	57430.0	552.10	31707103.	1191.0	45.9
.50000	57110.0	552.50	31553275.	1188.0	45.9
.55000	56340.0	553.60	31189824.	1182.0	45.8
.60000	55590.0	554.70	30835773.	1176.0	45.7
.65000	54900.0	555.80	30513420.	1171.0	45.7
.70000	54390.0	556.90	30289791.	1168.0	45.6
.75000	53830.0	557.90	30031757.	1165.0	45.6
.80000	53140.0	558.80	29694632.	1159.0	45.5
.85000	52510.0	559.60	29384596.	1154.0	45.5
.90000	52060.0	560.50	29179630.	1151.0	45.4
.95000	51590.0	561.20	28952308.	1147.0	45.4
1.00000	51060.0	561.90	28690614.	1143.0	45.3
1.10000	50410.0	563.20	28390912.	1139.0	44.9
1.20000	49760.0	564.20	28074592.	1139.0	43.6
1.30000	48680.0	565.00	27504200.	1134.0	42.0
1.40000	47330.0	565.60	26769848.	1125.0	40.2
1.50000	45950.0	566.30	26021485.	1117.0	38.4
1.60000	44720.0	567.00	25356240.	1110.0	36.9
1.70000	43650.0	567.80	24784470.	1104.0	35.7
1.80000	42610.0	568.60	24228046.	1099.0	34.6
1.90000	41490.0	569.30	23620257.	1093.0	33.5
2.00000	40320.0	570.10	22986432.	1087.0	32.4
2.10000	39180.0	570.90	22367862.	1082.0	31.3
2.20000	38130.0	571.70	21798921.	1077.0	30.4
2.30000	37180.0	572.70	21292986.	1073.0	29.6
2.40000	36830.0	573.60	21125688.	1067.0	28.6

TABLE 6.2-66E (CONT'D)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)	B.N.PRESS (PSIA)	DENSITY (LB/CU.FT.)
2.50000	36430.0	574.70	20936321.	1060.0	27.5
2.60000	36100.0	575.80	20786380.	1054.0	26.6
2.70000	35820.0	577.10	20671722.	1050.0	25.7
2.80000	35530.0	578.40	20550552.	1046.0	24.9
2.90000	35230.0	580.00	20433400.	1042.0	24.1
3.00000	34890.0	581.70	20295513.	1038.0	23.3
3.50000	32910.0	594.00	18548540.	1016.0	18.8
4.00000	29720.0	612.30	18197556.	964.0	13.8

TABLE 6.2-66F

MASS/ENERGY RELEASE RATES FOR 1400 SQ IN
SUCTION LEG GUILL. BREAK AT PUMP NOZZLE
FOR SUBCOMPARTMENT ANALYSIS OF
ST LUCIE II STRETCH POWER (2700 MWT)
(FLOW FROM PUMP SIDE)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)	B.N.PRESS (PSIA)	DENSITY (LB/CU.FT.)
0.00000	0.0	547.90	0.	2213.0	46.8
.00100	10130.0	546.90	5540097.	1973.0	46.7
.00200	15250.0	544.90	8309725.	1466.0	46.5
.00300	15230.0	543.20	8272936.	1045.0	46.3
.00400	19170.0	543.10	10411227.	1004.0	46.2
.00500	23940.0	543.10	13001814.	1003.0	46.0
.00600	28670.0	543.10	15570677.	1002.0	45.8
.00700	33350.0	543.10	18112385.	1000.0	45.5
.00800	37960.0	543.00	20612280.	998.5	45.0
.00900	42480.0	543.00	23066640.	996.4	44.7
.01000	46870.0	543.00	25450410.	993.8	44.2
.01200	45890.0	543.00	24918270.	986.2	42.7
.01400	44900.0	543.00	24380700.	978.2	41.3
.01600	43870.0	542.90	23817023.	970.1	39.9
.01800	42800.0	542.90	23236120.	961.7	38.5
.02000	41690.0	542.80	22629332.	953.2	37.2
.02200	40540.0	542.80	22005112.	944.4	35.9
.02400	39380.0	542.80	21375464.	935.7	34.7
.02600	38220.0	542.70	20741994.	927.2	33.5
.02800	37110.0	542.70	20139597.	919.2	32.5
.03000	36190.0	542.70	19640313.	912.2	31.6
.03200	36020.0	542.70	19548054.	905.9	30.9
.03400	35850.0	542.80	19459380.	900.4	30.2
.03600	35680.0	542.80	19367104.	895.6	29.6
.03800	35510.0	542.90	19278379.	891.1	29.1
.04000	35340.0	542.90	19186086.	886.7	28.6
.04200	35150.0	543.00	19086450.	882.2	28.1
.04400	34940.0	543.00	18972420.	877.6	27.7
.04600	34690.0	543.00	18836670.	872.8	27.2
.04800	34420.0	543.00	18690060.	867.9	26.7
.05000	34120.0	543.00	18527160.	862.9	26.2
.05500	33270.0	543.10	18068937.	851.4	25.2
.06000	32580.0	543.30	17700714.	842.5	24.3
.06500	32320.0	543.50	17565920.	835.5	23.6
.07000	32060.0	543.60	17427816.	828.4	23.0
.07500	31750.0	543.60	17259300.	820.1	22.4
.08000	31390.0	543.70	17066743.	810.5	21.7
.08500	30990.0	543.70	16849263.	800.2	20.8
.09000	30510.0	543.70	16588287.	790.7	20.2
.09500	30120.0	543.70	16376244.	780.4	19.5
.10000	29690.0	543.60	16139484.	769.0	18.7
.11000	28750.0	543.50	15625625.	744.4	17.2
.12000	27930.0	543.50	15179955.	723.3	16.0
.13000	27240.0	543.50	14804940.	706.3	15.1
.14000	26580.0	543.60	14448888.	690.3	14.3

TABLE 6.2-66F (CONT'D)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)	B.N.PRESS (PSIA)	DENSITY (LB/CU.FT.)
.15000	26020.0	543.70	14147074.	676.8	13.7
.16000	25740.0	543.90	13999986.	670.1	13.3
.17000	25640.0	544.20	13953288.	668.1	13.2
.18000	25450.0	544.20	13849890.	664.1	13.0
.19000	25190.0	544.20	13708398.	658.1	12.8
.20000	24960.0	544.30	13585728.	652.7	12.5
.22000	24380.0	544.30	13270034.	639.5	12.0
.24000	24470.0	544.60	13326362.	641.3	12.0
.26000	24490.0	544.70	13339703.	642.1	12.1
.28000	24540.0	544.70	13366938.	643.5	12.1
.30000	24190.0	544.60	13173874.	635.7	11.8
.32000	24090.0	544.60	13119414.	633.0	11.7
.34000	24170.0	544.80	13167816.	634.8	11.8
.36000	24050.0	544.70	13100035.	632.7	11.7
.38000	23850.0	544.70	12991095.	628.0	11.5
.40000	23650.0	544.70	12882155.	623.4	11.4
.42000	23600.0	544.80	12857280.	622.2	11.3
.44000	23410.0	544.70	12751427.	618.5	11.2
.46000	23090.0	544.70	12577123.	611.2	10.9
.48000	22860.0	544.70	12451842.	605.9	10.7
.50000	22760.0	544.80	12399648.	603.6	10.6
.55000	22170.0	544.70	12075999.	588.1	10.1
.60000	21650.0	544.80	11794920.	575.3	9.6
.65000	21060.0	544.90	11475594.	561.6	9.1
.70000	20650.0	544.90	11252185.	552.5	8.9
.75000	20250.0	545.00	11036250.	544.0	8.6
.80000	19810.0	545.10	10798431.	535.1	8.3
.85000	19450.0	545.10	10602195.	527.9	8.1
.90000	19120.0	545.20	10424224.	521.2	7.9
.95000	18780.0	545.20	10238856.	515.2	7.7
1.00000	18550.0	545.30	10115315.	510.9	7.6
1.10000	18230.0	545.40	9942642.	505.3	7.5
1.20000	18000.0	545.50	9819000.	501.3	7.3
1.30000	17750.0	545.60	9684400.	497.0	7.2
1.40000	17450.0	545.60	9520720.	492.0	7.1
1.50000	17150.0	545.70	9358755.	486.9	7.0
1.60000	16900.0	545.80	9224020.	482.7	6.9
1.70000	16690.0	545.90	9111071.	479.5	6.8
1.80000	16510.0	546.00	9014460.	476.7	6.7
1.90000	16360.0	546.20	8935832.	473.2	6.6
2.00000	16180.0	546.30	8839134.	468.5	6.5
2.10000	16020.0	546.40	8753328.	463.9	6.4
2.20000	15870.0	546.60	8674542.	459.8	6.3
2.30000	15720.0	546.80	8595696.	455.9	6.2
2.40000	15580.0	546.90	8520702.	452.2	6.1

TABLE 6.2-66F (CONT'D)

TIME (SECONDS)	FLOW RATE (LB/SEC)	ENTHALPY (BTU/LB)	ENERGY RATE (BTU/SEC)	B.N.PRESS (PSIA)	DENSITY (LB/CU.FT.)
2.50000	15450.0	547.10	8452695.	448.9	6.0
2.60000	15370.0	547.40	8413538.	446.7	5.9
2.70000	15260.0	547.60	8356376.	443.9	5.9
2.80000	15190.0	547.80	8321082.	442.2	5.8
2.90000	15140.0	548.10	8298234.	441.2	5.8
3.00000	15020.0	548.40	8236968.	438.5	5.7
3.50000	14450.0	550.20	7950390.	425.1	5.4
4.00000	13350.0	652.70	7378545.	398.6	4.8

Table 6.2-67A
This table has been deleted.

TABLE 6.2-67B

MSLB MASS/ENERGY RELEASE RATE FOR ST. LUCIE 2 STRETCH POWER SLB
(Loss of Containment Cooling)
Increased Core Inlet Temp.
(Historical)

Time (sec.)	Mass flow (lbm/sec)	Energy release rate (BTU/sec)	Time (sec.)	Mass flow (lbm/sec)	Energy release rate (BTU/sec)
0.00	14045.1	1.680E+07	11.00	5926.2	7.138E+06
.20	13543.3	1.622E+07	11.50	5722.1	6.892E+06
.40	13088.1	1.568E+07	12.00	5525.8	6.655E+06
.60	12695.1	1.522E+07	12.50	5337.0	6.427E+06
.80	12343.6	1.481E+07	13.00	5168.6	6.223E+06
1.00	12022.4	1.443E+07	13.50	5009.5	6.031E+06
1.50	11144.7	1.339E+07	14.00	4857.5	5.847E+06
2.00	10412.1	1.252E+07	14.50	4714.5	5.674E+06
2.50	9818.0	1.181E+07	15.00	4581.7	5.513E+06
3.00	9331.0	1.123E+07	15.50	4459.9	5.365E+06
3.50	8928.9	1.075E+07	16.00	4349.3	5.231E+06
4.00	8633.9	1.039E+07	16.50	4250.0	5.111E+06
4.50	8460.0	1.018E+07	17.00	4161.5	5.003E+06
5.00	8341.3	1.004E+07	17.50	4083.2	4.909E+06
5.50	8262.8	9.947E+06	18.00	4014.3	4.825E+06
6.00	8214.2	9.888E+06	18.50	3953.8	4.752E+06
6.50	8190.3	9.860E+06	19.00	3899.9	4.686E+06
7.00	8182.7	9.851E+06	19.50	3852.3	4.629E+06
7.50	8190.8	9.859E+06	20.00	3808.9	4.576E+06
8.00	8203.9	9.876E+06	20.50	3767.9	4.526E+06
8.50	8213.9	9.888E+06	21.00	3729.2	4.479E+06
9.00	8216.6	9.891E+06	21.50	3692.0	4.434E+06
9.50	6631.4	7.988E+06	22.00	3655.8	4.390E+06
10.00	6370.7	7.674E+06	22.50	3620.0	4.347E+06
10.50	6140.3	7.396E+06	23.00	3583.9	4.303E+06

TABLE 6.2-67B (CONT'D)
(Historical)

Time (sec.)	Mass flow (lbm/sec)	Energy release rate (BTU/sec)	Time (sec.)	Mass flow (lbm/sec)	Energy release rate (BTU/sec)
23.50	3547.4	4.259E+06	36.00	2823.7	3.381E+06
24.00	3510.4	4.214E+06	36.50	2803.1	3.356E+06
24.50	3472.7	4.168E+06	37.00	2782.3	3.330E+06
25.00	3434.5	4.122E+06	37.50	2761.1	3.305E+06
25.50	3396.2	4.075E+06	38.00	2739.8	3.279E+06
26.00	3357.8	4.029E+06	38.50	2718.4	3.253E+06
26.50	3319.8	3.983E+06	39.00	2194.9	2.619E+06
27.00	3282.5	3.937E+06	39.50	2006.0	2.383E+06
27.50	3246.2	3.893E+06	40.00	1491.8	1.833E+06
28.00	3211.2	3.851E+06	40.50	549.7	6.480E+05
28.50	3177.6	3.810E+06	41.00	266.4	3.244E+05
29.00	3145.8	3.771E+06	41.50	127.8	1.586E+05
29.50	3115.6	3.735E+06	42.00	54.0	6.769E+04
30.00	3087.3	3.700E+06	42.50	26.3	3.322E+04
30.50	3060.6	3.668E+06	43.00	15.9	2.010E+04
31.00	3035.3	3.637E+06	43.50	11.0	1.393E+04
31.50	3010.7	3.607E+06	44.00	8.0	1.015E+04
32.00	2987.6	3.579E+06	44.50	6.0	7.563E+03
32.50	2965.6	3.553E+06	45.00	4.6	5.863E+03
33.00	2944.5	3.527E+06	45.50	3.9	4.947E+03
33.50	2924.0	3.502E+06	46.00	3.8	4.748E+03
34.00	2903.9	3.478E+06	46.50	4.1	5.180E+03
34.50	2884.0	3.454E+06	47.00	4.9	6.140E+03
35.00	2864.1	3.430E+06	47.50	6.0	7.507E+03
35.50	2844.0	3.405E+06	48.00	7.3	9.147E+03

TABLE 6.2-67C

MSLB MASS/ENERGY RELEASE RATE FOR ST. LUCIE 2 STRETCH POWER SLB
(Loss of Containment Cooling)
Decreased RCS Flow Rate
(Historical)

Time (sec.)	Mass flow (lbm/sec)	Energy release rate (BTU/sec)	Time (sec.)	Mass flow (lbm/sec)	Energy release rate (BTU/sec)
0.00	14045.1	1.680E+07	11.00	5918.6	7.129E+06
.20	13541.4	1.621E+07	11.50	5720.1	6.889E+06
.40	13084.7	1.568E+07	12.00	5528.5	6.658E+06
.60	12690.4	1.522E+07	12.50	5343.1	6.434E+06
.80	12337.7	1.481E+07	13.00	5176.3	6.232E+06
1.00	12015.6	1.443E+07	13.50	5018.2	6.041E+06
1.50	11135.9	1.338E+07	14.00	4866.0	5.857E+06
2.00	10401.8	1.251E+07	14.50	4721.7	5.682E+06
2.50	9807.8	1.180E+07	15.00	4586.6	5.519E+06
3.00	9318.5	1.122E+07	15.50	4461.8	5.367E+06
3.50	8914.4	1.073E+07	16.00	4347.6	5.229E+06
4.00	8616.7	1.037E+07	16.50	4244.4	5.104E+06
4.50	8438.9	1.016E+07	17.00	4151.8	4.992E+06
5.00	8318.9	1.001E+07	17.50	4069.6	4.892E+06
5.50	8237.3	9.916E+06	18.00	3997.0	4.804E+06
6.00	8183.3	9.851E+06	18.50	3933.1	4.727E+06
6.50	8154.6	9.817E+06	19.00	3876.8	4.658E+06
7.00	8146.5	9.807E+06	19.50	3826.6	4.597E+06
7.50	8150.8	9.812E+06	20.00	3782.1	4.543E+06
8.00	8164.1	9.828E+06	20.50	3740.5	4.493E+06
8.50	8176.0	9.843E+06	21.00	3701.9	4.446E+06
9.00	8181.3	9.849E+06	21.50	3665.5	4.402E+06
9.50	6605.8	7.957E+06	22.00	3630.6	4.360 E+06
10.00	6350.9	7.650E+06	22.50	3596.5	4.318E+06
10.50	6126.7	7.380E+06	23.00	3562.6	4.277E+06

TABLE 6.2-67C (CONT'D)
(Historical)

Time (sec.)	Mass flow (lbm/sec)	Energy release rate (BTU/sec)	Time (sec.)	Mass flow (lbm/sec)	Energy release rate (BTU/sec)
23.50	3528.4	4.236E+06	36.00	2810.0	3.364E+06
24.00	3493.8	4.194E+06	36.50	2790.6	3.340E+06
24.50	3458.5	4.151E+06	37.00	2770.8	3.317E+06
25.00	3422.5	4.107E+06	37.50	2750.8	3.292E+06
25.50	3386.0	4.063E+06	38.00	2730.6	3.268E+06
26.00	3349.2	4.018E+06	38.50	2710.0	3.243E+06
26.50	3312.4	3.973E+06	39.00	2502.9	2.992E+06
27.00	3275.7	3.929E+06	39.50	1817.6	2.062E+06
27.50	3239.6	3.885E+06	40.00	1737.3	2.061E+06
28.00	3204.4	3.842E+06	40.50	1045.1	1.275E+06
28.50	3170.3	3.801E+06	41.00	463.9	5.649E+05
29.00	3137.5	3.761E+06	41.50	180.6	2.227E+05
29.50	3106.3	3.723E+06	42.00	75.2	9.404E+04
30.00	3076.7	3.688E+06	42.50	34.6	4.357E+04
30.50	3048.8	3.654E+06	43.00	19.3	2.435E+04
31.00	3021.6	3.621E+06	43.50	12.9	1.634E+04
31.50	2995.9	3.590E+06	44.00	9.4	1.182E+04
32.00	2971.9	3.560E+06	44.50	6.9	8.761E+03
32.50	2949.2	3.533E+06	45.00	5.3	6.641E+03
33.00	2927.7	3.507E+06	45.50	4.2	5.314E+03
33.50	2907.1	3.482E+06	46.00	3.7	4.715E+03
34.00	2887.1	3.458E+06	46.50	3.8	4.777E+03
34.50	2807.7	3.434E+06	47.00	4.3	5.413E+03
35.00	2848.4	3.411E+06	47.50	5.2	6.518E+03
35.50	2829.3	3.387E+06	48.00	6.3	7.972E+03

TABLE 6.2-67D

MSLB MASS/ENERGY RELEASE RATE FOR ST. LUCIE 2 STRETCH POWER SLB
(MSIV Failure)
Increased Core Inlet Temp.
Decreased RCS Flow Rate
(Historical)

Time (sec.)	Mass flow (lbm/sec)	Energy release rate (BTU/sec)	Time (sec.)	Mass flow (lbm/sec)	Energy release rate (BTU/sec)
0.00	14045.1	1.680E+07	11.00	7162.6	8.628E+06
.20	13544.8	1.622E+07	11.50	6754.4	8.136E+06
.40	13091.0	1.569E+07	12.00	6400.3	7.708E+06
.60	12699.2	1.523E+07	12.50	6089.3	7.333E+06
.80	12348.7	1.482E+07	13.00	5813.9	7.000E+06
1.00	12028.3	1.444E+07	13.50	5573.0	6.709E+06
1.50	11152.9	1.340E+07	14.00	5356.2	6.447E+06
2.00	10419.5	1.253E+07	14.50	5159.6	6.209E+06
2.50	9824.7	1.182E+07	15.00	4980.2	5.992E+06
3.00	9336.6	1.124E+07	15.50	4816.7	5.794E+06
3.50	8933.6	1.076E+07	16.00	4867.5	5.614E+06
4.00	8635.2	1.040E+07	16.50	4532.1	5.450E+06
4.50	8458.6	1.016E+07	17.00	4409.8	5.302E+06
5.00	8338.8	1.004E+07	17.50	4300.8	5.169E+06
5.50	8257.8	9.941E+06	18.00	4202.2	5.050E+06
6.00	8207.3	9.880E+06	18.50	4115.4	4.945E+06
6.50	8180.8	9.848E+06	19.00	4038.9	4.856E+06
7.00	8173.5	9.840E+06	19.50	3971.4	4.771E+06
7.50	8181.9	9.850E+06	20.00	3912.0	4.699E+06
8.00	8196.7	9.867E+06	20.50	3859.1	4.635E+06
8.50	8211.6	9.885E+06	21.00	3811.7	4.578E+06
9.00	8218.5	9.893E+06	21.50	3768.4	4.526E+06
9.50	8177.3	9.847E+06	22.00	3728.5	4.477E+06
10.00	7953.3	9.580E+06	22.50	3690.0	4.431E+06
10.50	7638.8	9.202E+06	23.00	3653.7	4.387E+06

TABLE 6.2-67D (CONT'D)
(Historical)

Time (sec.)	Mass flow (lbm/sec)	Energy release rate (BTU/sec)	Time (sec.)	Mass flow (lbm/sec)	Energy release rate (BTU/sec)
23.50	3618.2	4.344E+06	36.00	2860.0	3.424E+06
24.00	3583.2	4.301E+06	36.50	2840.4	3.400E+06
24.50	3548.2	4.259E+06	37.00	2821.5	3.377E+06
25.00	3512.7	4.215E+06	37.50	2801.5	3.353E+06
25.50	3476.7	4.172E+06	38.00	2781.7	3.329E+06
26.00	3440.2	4.127E+06	38.50	2761.9	3.305E+06
26.50	3402.7	4.082E+06	39.00	2598.4	3.101E+06
27.00	3365.1	4.036E+06	39.50	2365.4	2.813E+06
27.50	3327.6	3.991E+06	40.00	2165.7	2.571E+06
28.00	3290.2	3.945E+06	40.50	1349.8	1.625E+06
28.50	3253.3	3.901E+06	41.00	827.8	9.892E+05
29.00	3217.8	3.858E+06	41.50	574.1	6.903E+05
29.50	3183.1	3.816E+06	42.00	373.0	4.499E+05
30.00	3149.6	3.775E+06	42.50	216.2	2.611E+05
30.50	3118.3	3.737E+06	43.00	104.5	1.271E+05
31.00	3088.4	3.701E+06	43.50	36.7	4.532E+04
31.50	2059.7	3.666E+06	44.00	27.3	3.351E+04
32.00	3033.0	3.634E+06	44.50	24.3	2.965E+04
32.50	3007.2	3.602E+06	45.00	22.3	2.711E+04
33.00	2983.4	3.573E+06	45.50	21.2	2.574E+04
33.50	2960.5	3.546E+06	46.00	19.9	2.414E+04
34.00	2938.9	3.520E+06	46.50	20.0	2.425E+04
34.50	2918.4	3.495E+06	47.00	20.5	2.490E+04
35.00	2898.4	3.471E+06	47.50	21.4	2.597E+04
35.50	2879.4	3.448E+06	48.00	23.3	2.837E+04

Table 6.2-67E
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Table 6.2-67F
This table has been deleted.

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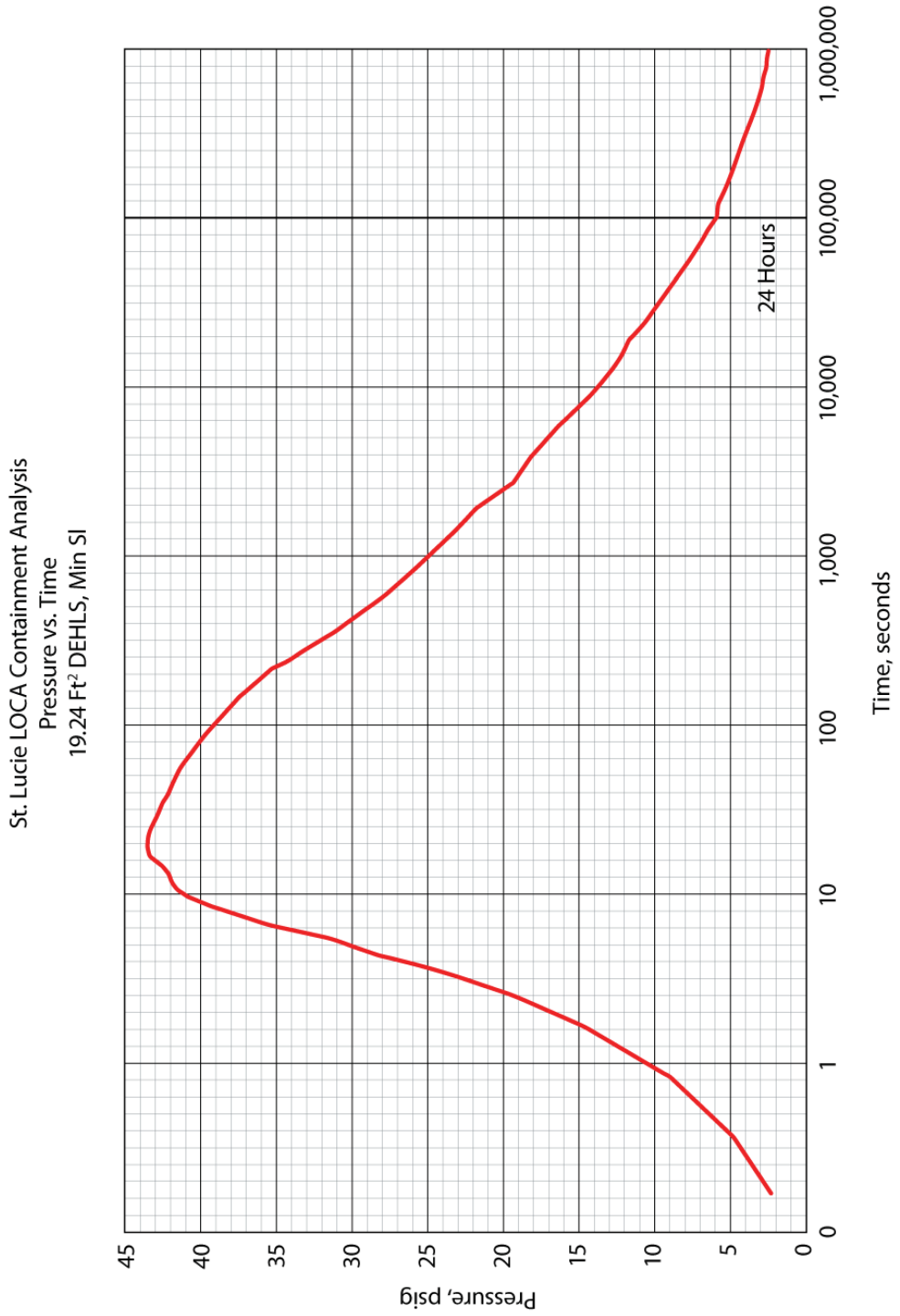
Amendment No. 8, (9/93)

FLORIDA POWER & LIGHT COMPANY

ST. LUCIE PLANT UNIT 2

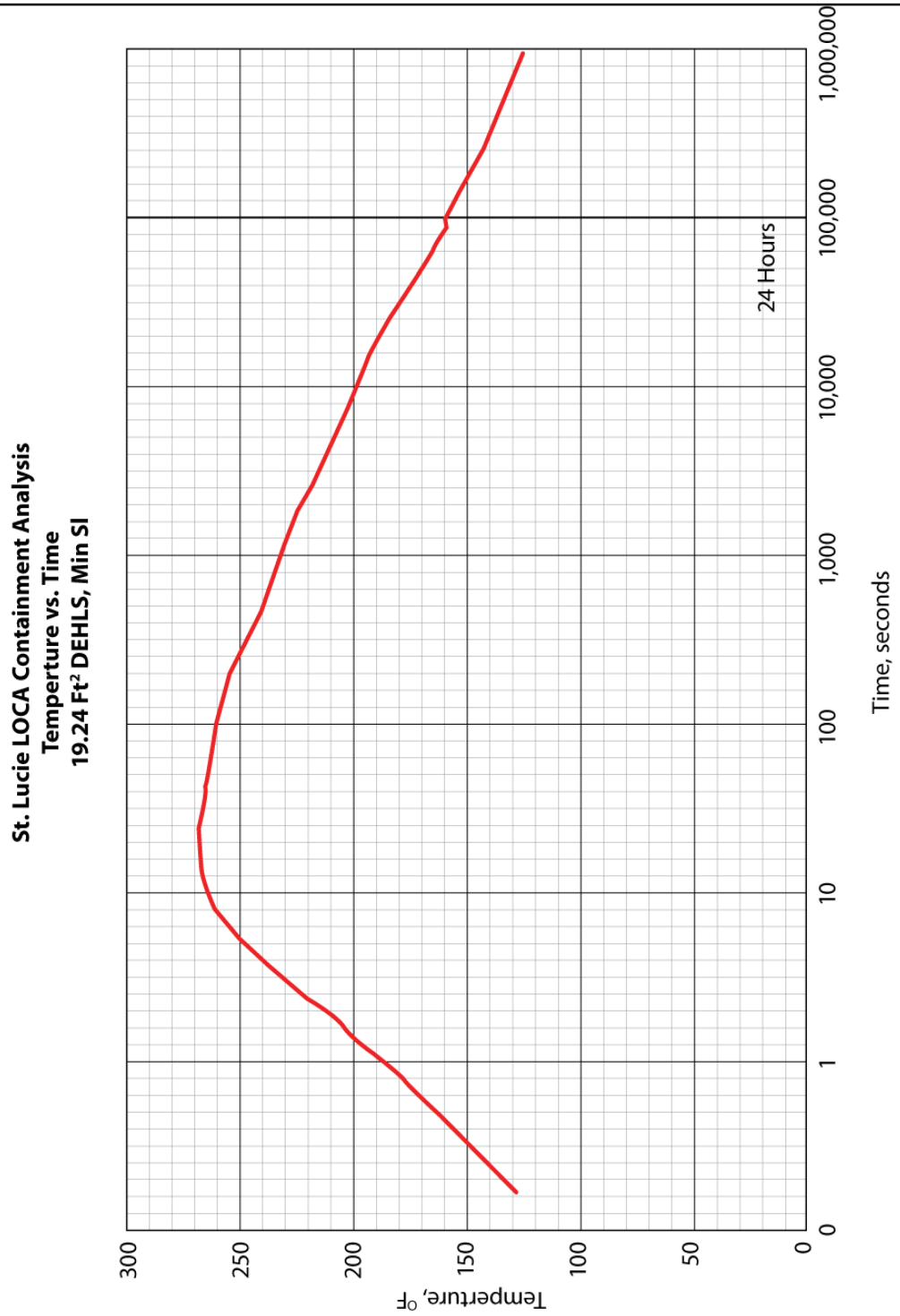
FIGURE 6.2-1



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

LOCA Containment Analysis
Pressure vs. Time
19.24 ft^2 DEHLS, Min SI
FIGURE 6.2-2a

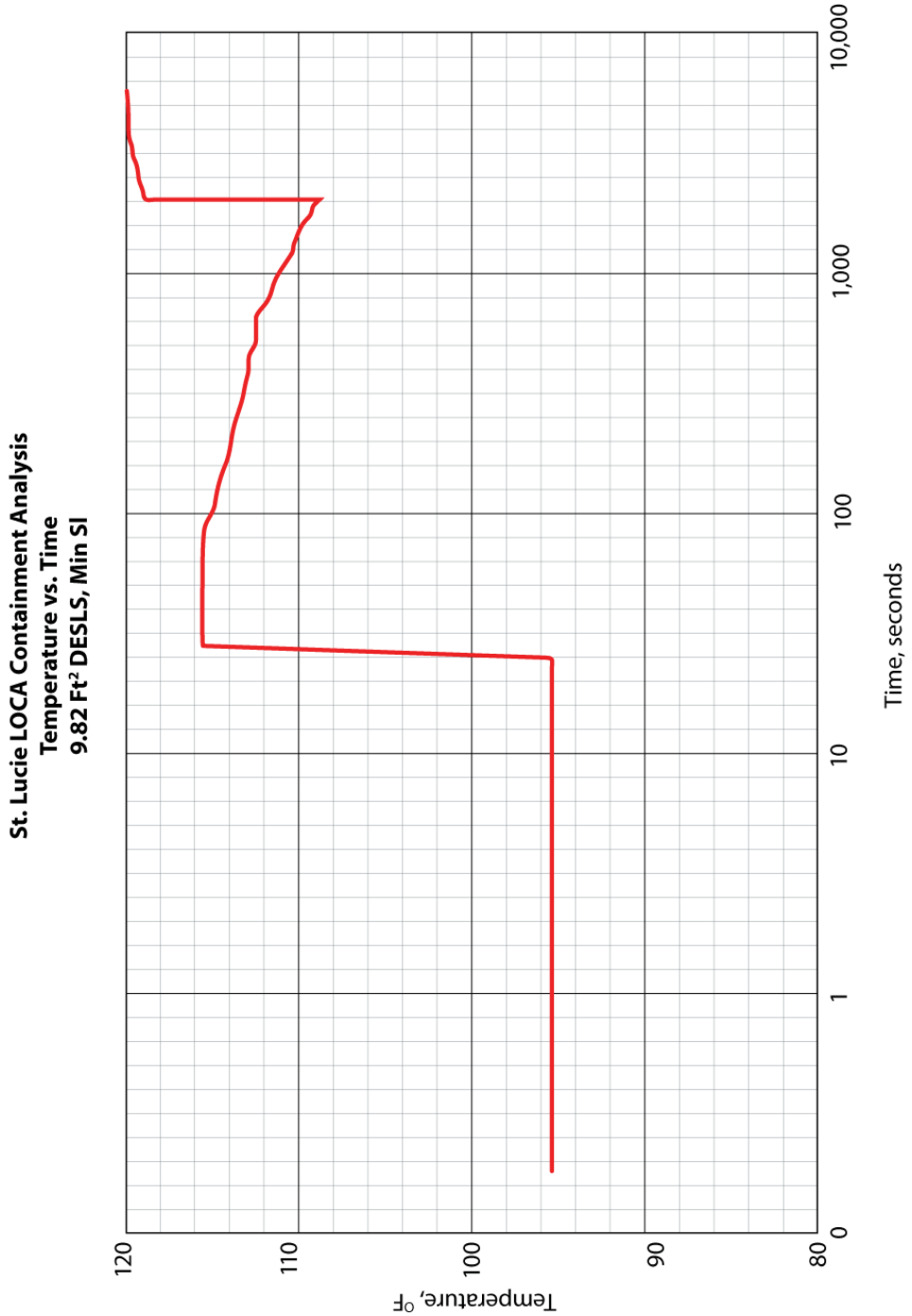
Amendment No. 21 (11/12)



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

LOCA Containment Analysis
Temperature vs. Time
19.24 ft^2 DEHLS, Min SI
FIGURE 6.2-2b

Amendment No. 21 (11/12)



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

LOCA Containment Analysis
Temperature vs. Time
9.82 ft^2 DESLS, Min SI
FIGURE 6.2-3a

Amendment No. 21 (11/12)

DELETED

Amendment No. 8, (9/93)

FLORIDA POWER & LIGHT COMPANY

ST. LUCIE PLANT UNIT 2

FIGURE 6.2-4

DELETED

Amendment No. 8, (9/93)

FLORIDA POWER & LIGHT COMPANY

ST. LUCIE PLANT UNIT 2

FIGURE 6.2-5

DELETED

Amendment No. 8, (9/93)

FLORIDA POWER & LIGHT COMPANY

ST. LUCIE PLANT UNIT 2

FIGURE 6.2-6

DELETED

Amendment No. 8, (9/93)

FLORIDA POWER & LIGHT COMPANY

ST. LUCIE PLANT UNIT 2

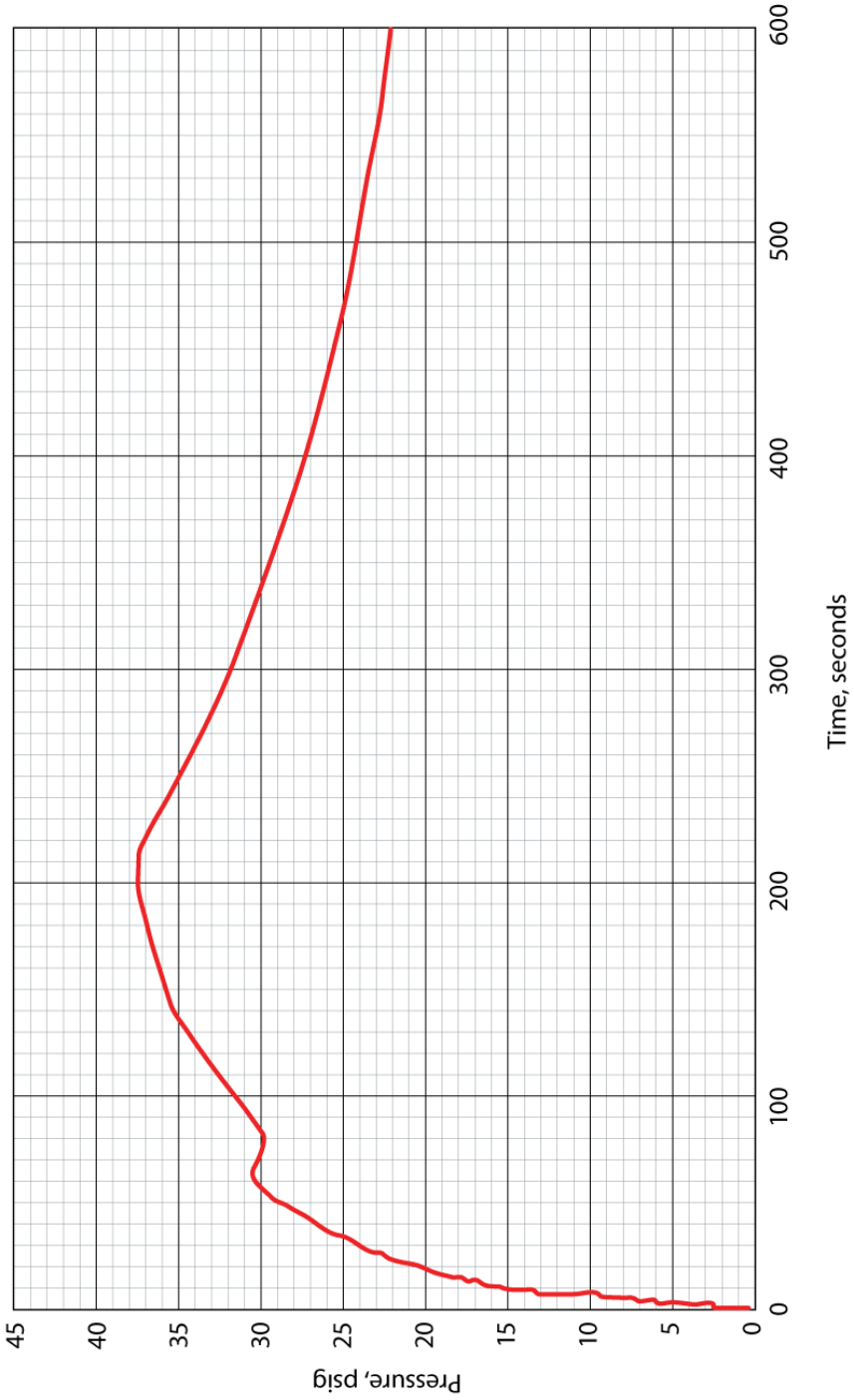
FIGURE 6.2-7

Amendment No. 8, (9/93)

FLORIDA POWER & LIGHT COMPANY

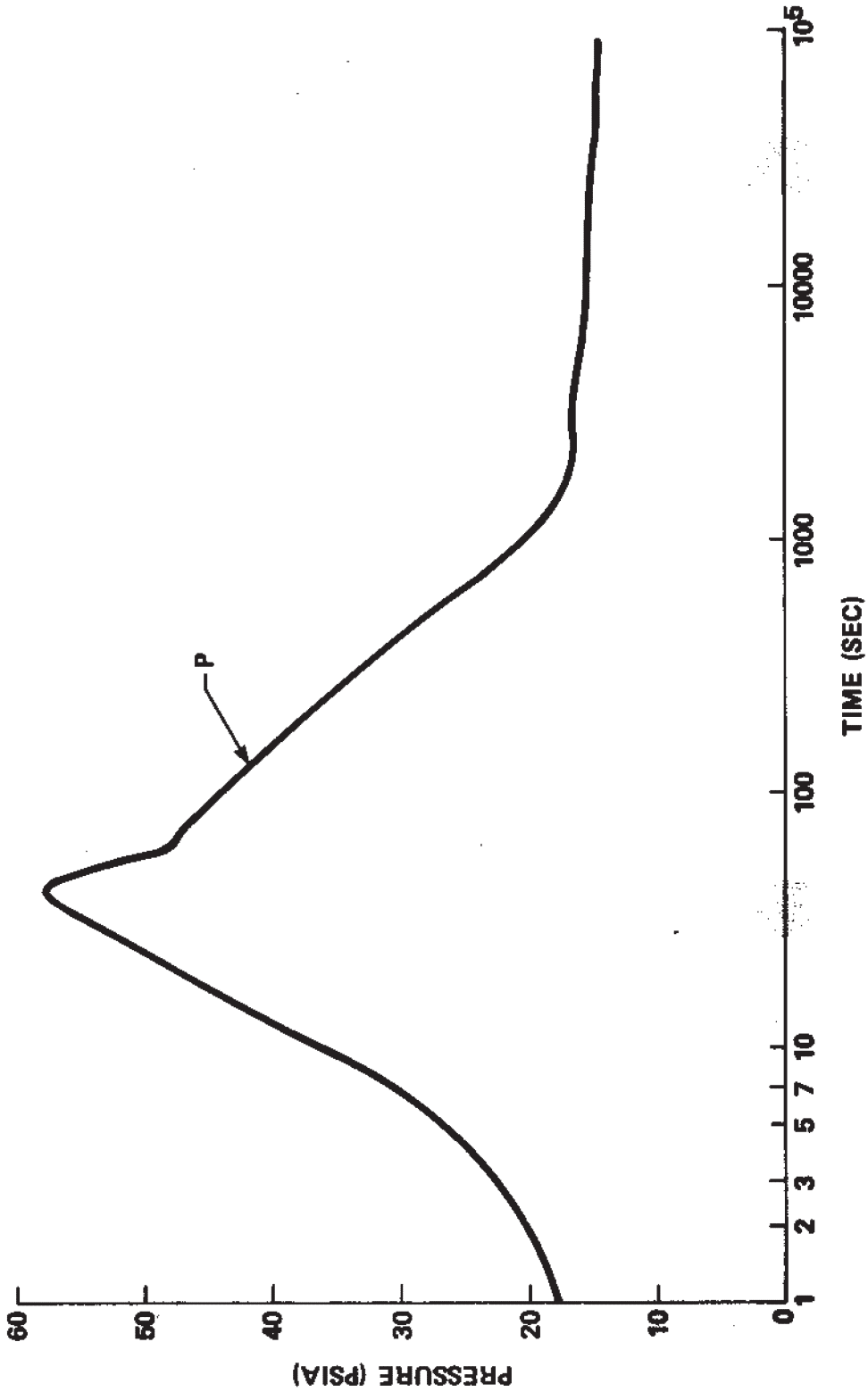
ST. LUCIE PLANT UNIT 2

FIGURE 6.2-8



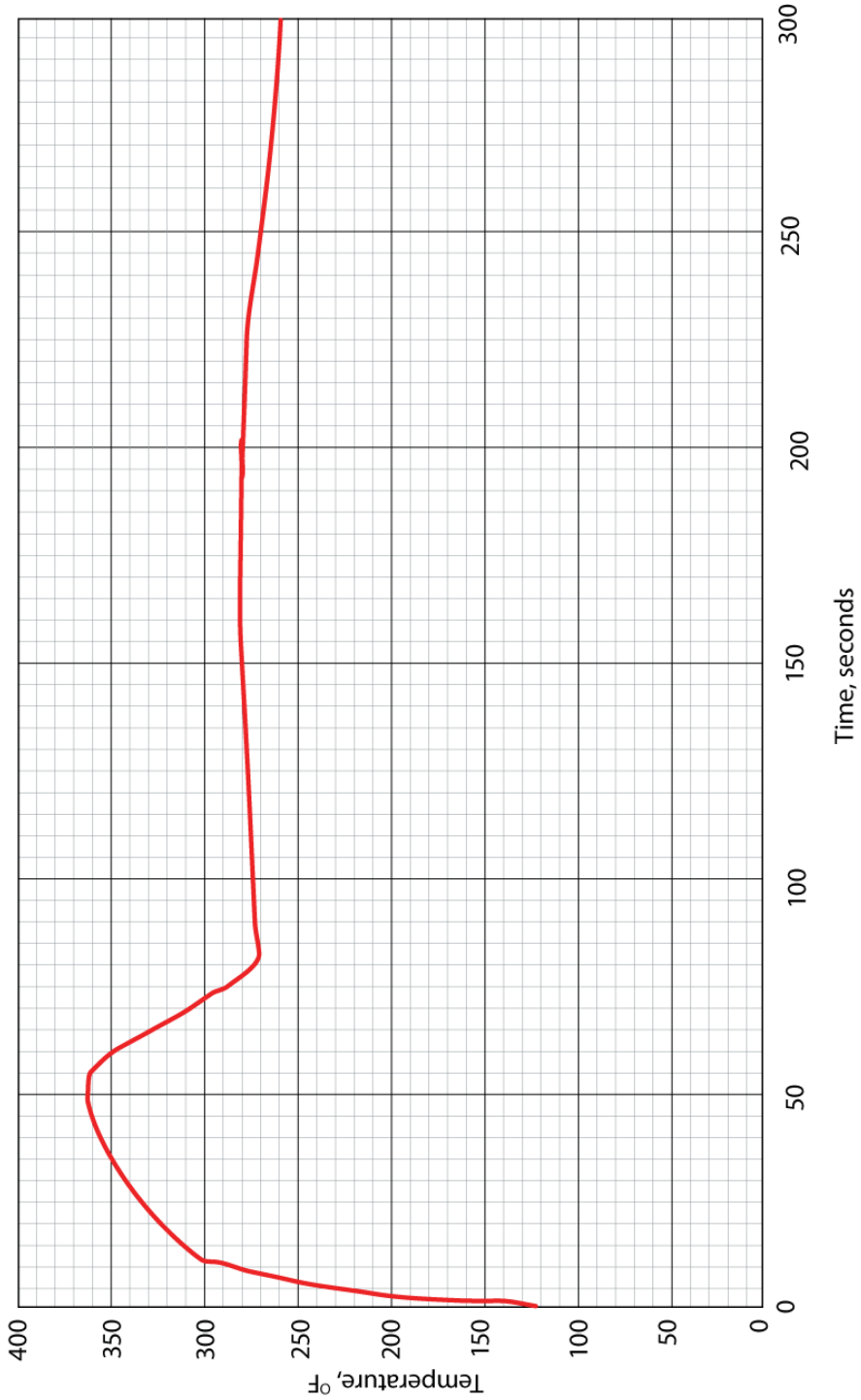
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

CONTAINMENT PRESSURE-MSLB-FAILURE OF ONE CONTAINMENT COOLING TRAIN AT 0.0% POWER
FIGURE 6.2-9



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

CONTAINMENT PRESSURE – MSLB-MSIV FAILURE AT 102% POWER
FIGURE 6.2–9a



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

CONTAINMENT TEMPERATURE-MSLB-FAILURE OF ONE CONTAINMENT COOLING TRAIN AT 0.0% POWER
FIGURE 6.2-10

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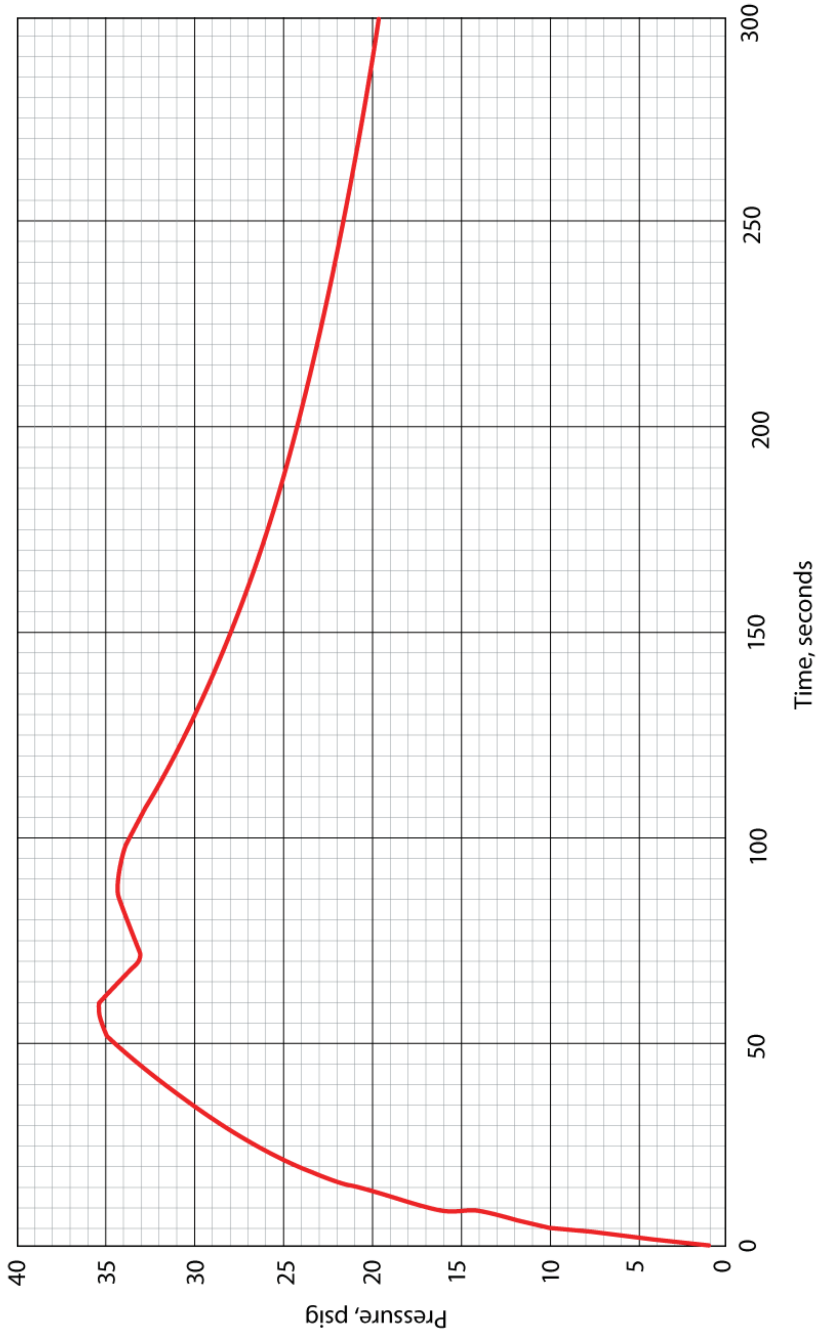
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

CONTAINMENT TEMP-MSLB-MSIV
FAILURE AT 102% POWER

FIGURE 6.2-10a

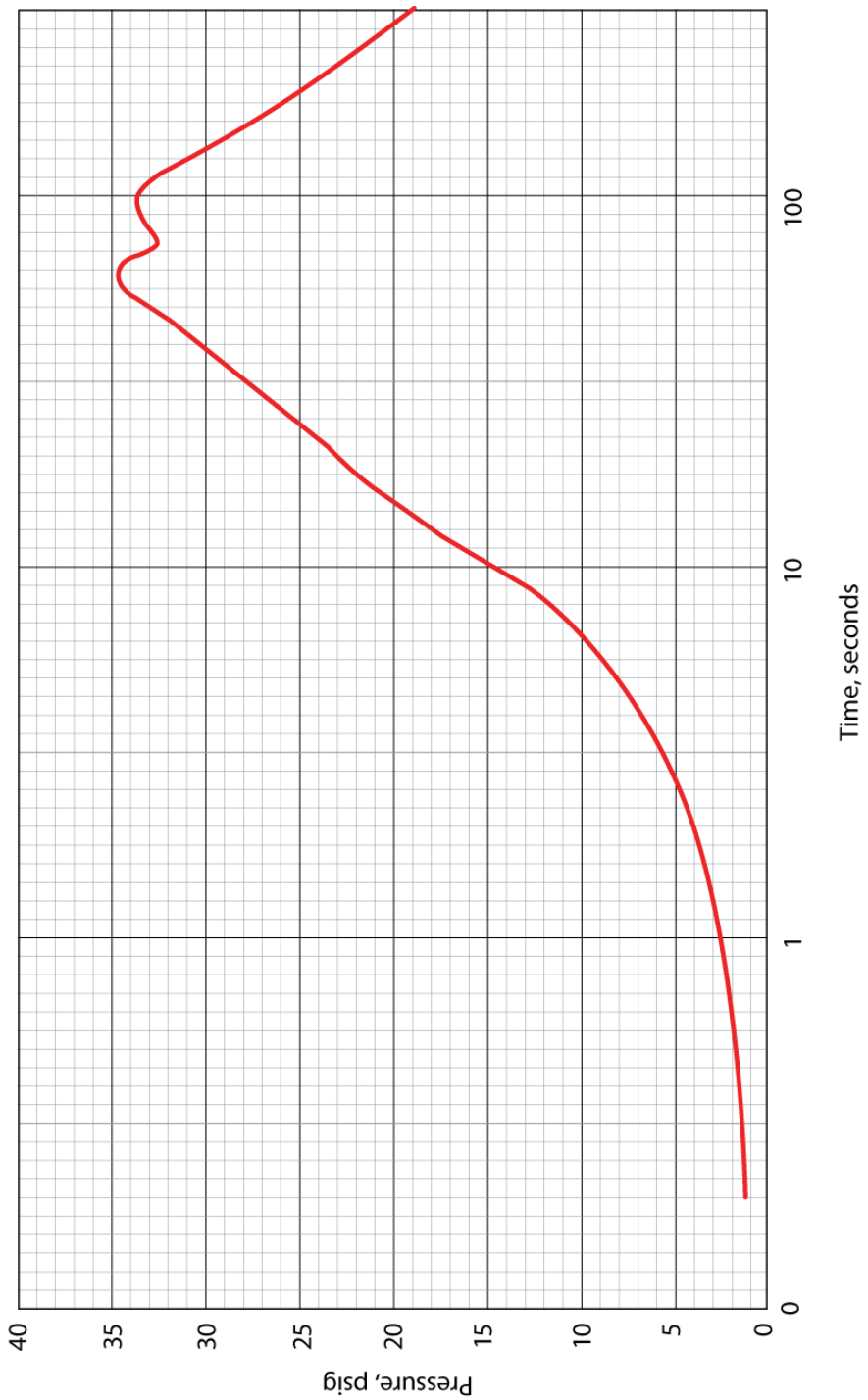


FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

CONTAINMENT PRESSURE - MSLB-MSIV FAILURE AT 100.3% POWER

FIGURE 6.2-11

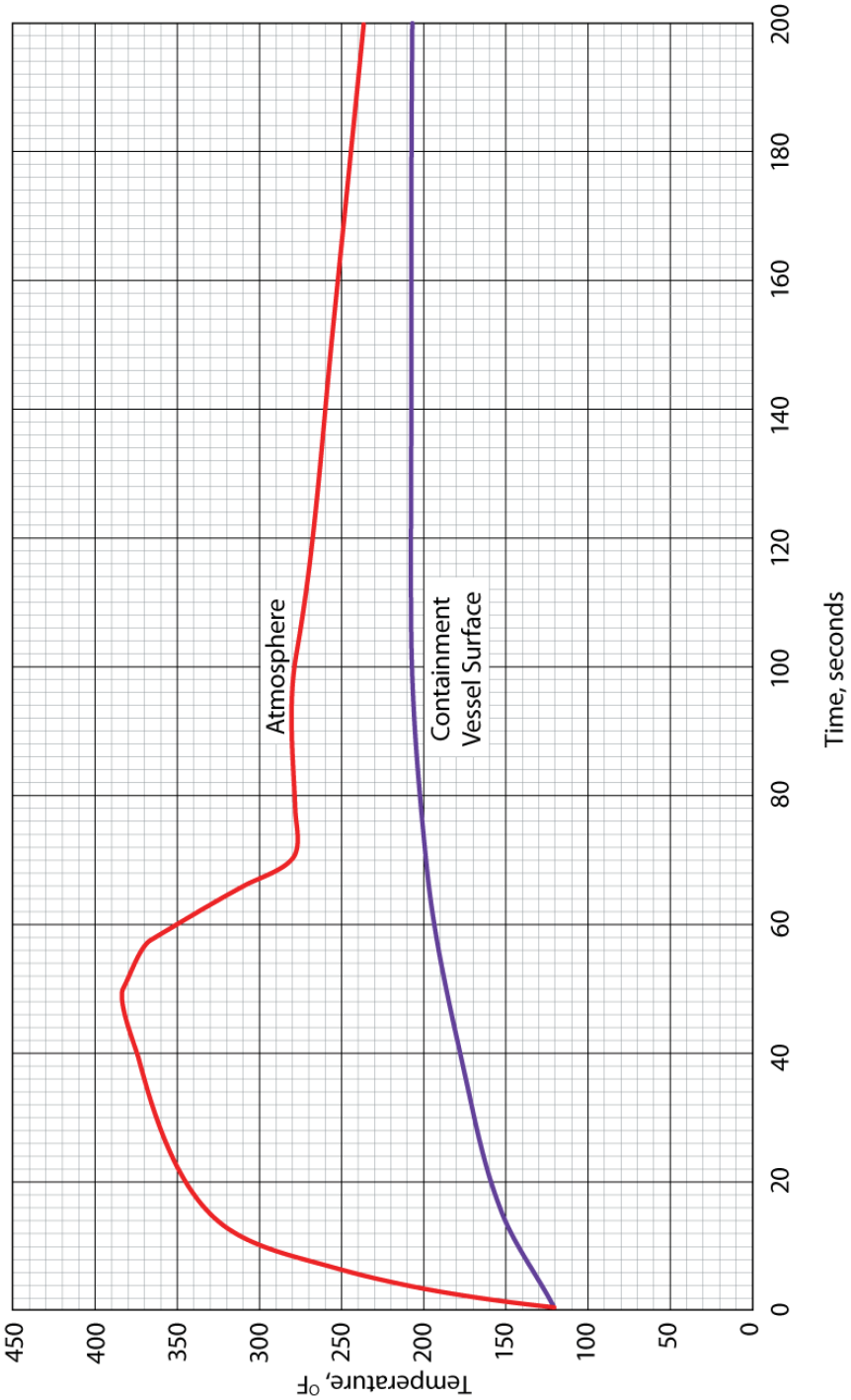
Amendment No. 21 (11/12)



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

CONTAINMENT PRESSURE - MSLB-MSIV FAILURE AT 100.3% POWER

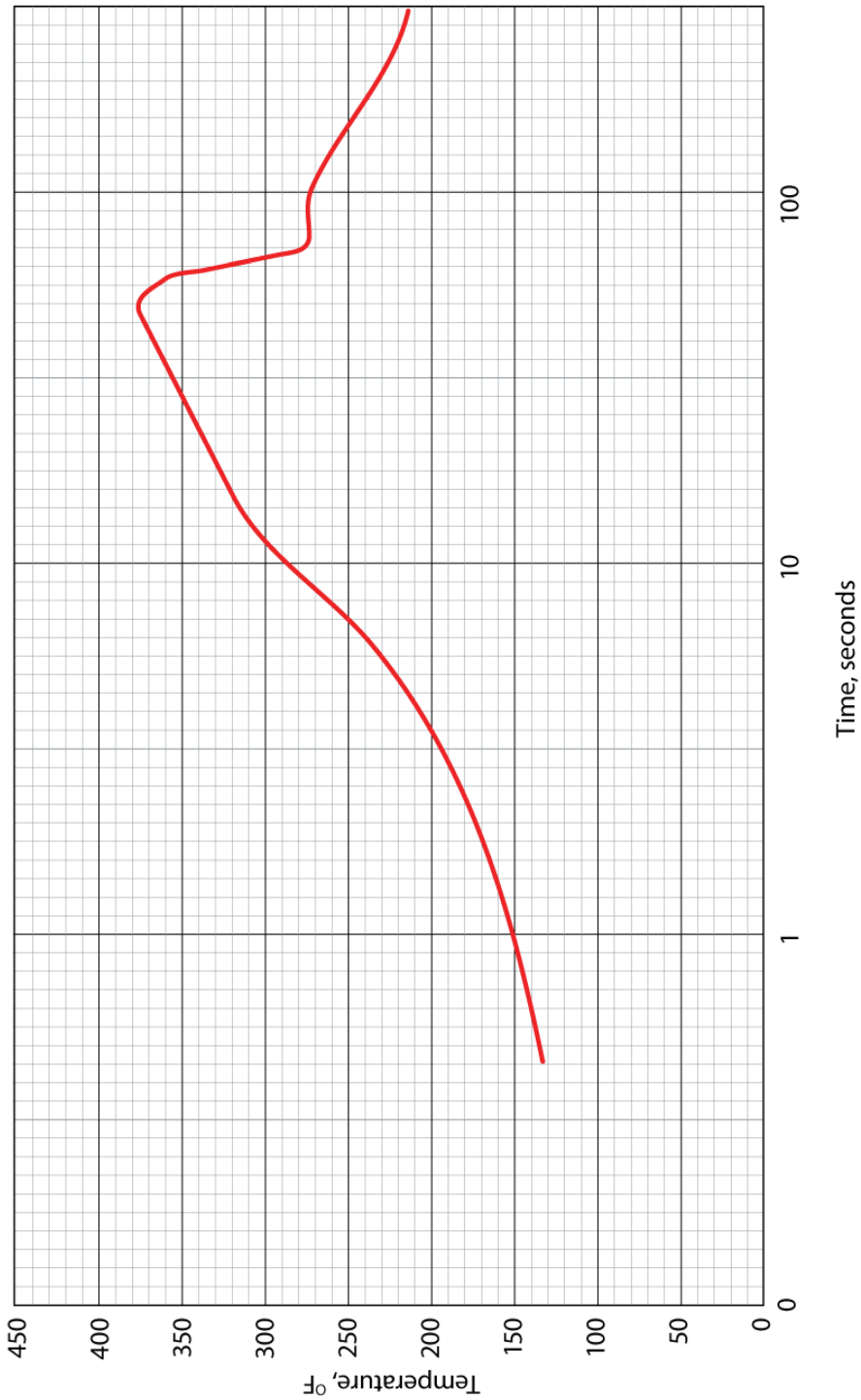
FIGURE 6.2-11a



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

CONTAINMENT TEMPERATURE-MSLB-MSIV FAILURE AT 100.3% POWER

FIGURE 6.2-12



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

CONTAINMENT TEMPERATURE-MSLB-MSIV FAILURE AT 100.3% POWER

FIGURE 6.2-12a

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FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SHIELD WALL TEMP. GRADIENTS AS A FUNCTION OF TIME – 7.6257 FT^2 MSLB AT 102% PWR.COOL. TRAIN FAILURE
FIGURE 6.2-13

DELETED

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

UCHIDA COND. HEAT TRANSF. COEFF.
MSIV FAILURE AT 102% POWER
(DBA MSLB PRESSURE)
FIGURE 6.2-14

DELETED

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

UCHIDA COND. HEAT TRANSF. COEFF.
COOLING TRAIN FAILURE 102% POWER
(DBA MDLB TEMPERATURE)
FIGURE 6.2-15

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EC280084

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ST. LUCIE PLANT UNIT 2

FIGURE 6.2-16

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EC280084

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

FIGURE 6.2-17

Withheld Under 10 CFR 2.390

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

REACTOR BUILDING – GENERAL ARRANGEMENTS SHOWING SUBCOMPARTMENT MODEL – SHEET 1

FIGURE 6.2-18

Withheld Under 10 CFR 2.390

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

REACTOR BUILDING – GENERAL ARRANGEMENTS SHOWING SUBCOMPARTMENT MODEL – SHEET 2

FIGURE 6.2-19

Withheld Under 10 CFR 2.390

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

REACTOR BUILDING – GENERAL ARRANGEMENTS SHOWING SUBCOMPARTMENT MODEL – SHEET 3

FIGURE 6.2-20

Withheld Under 10 CFR 2.390

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

REACTOR BUILDING – GENERAL ARRANGEMENTS SHOWING SUBCOMPARTMENT MODEL – SHEET 4

FIGURE 6.2-21

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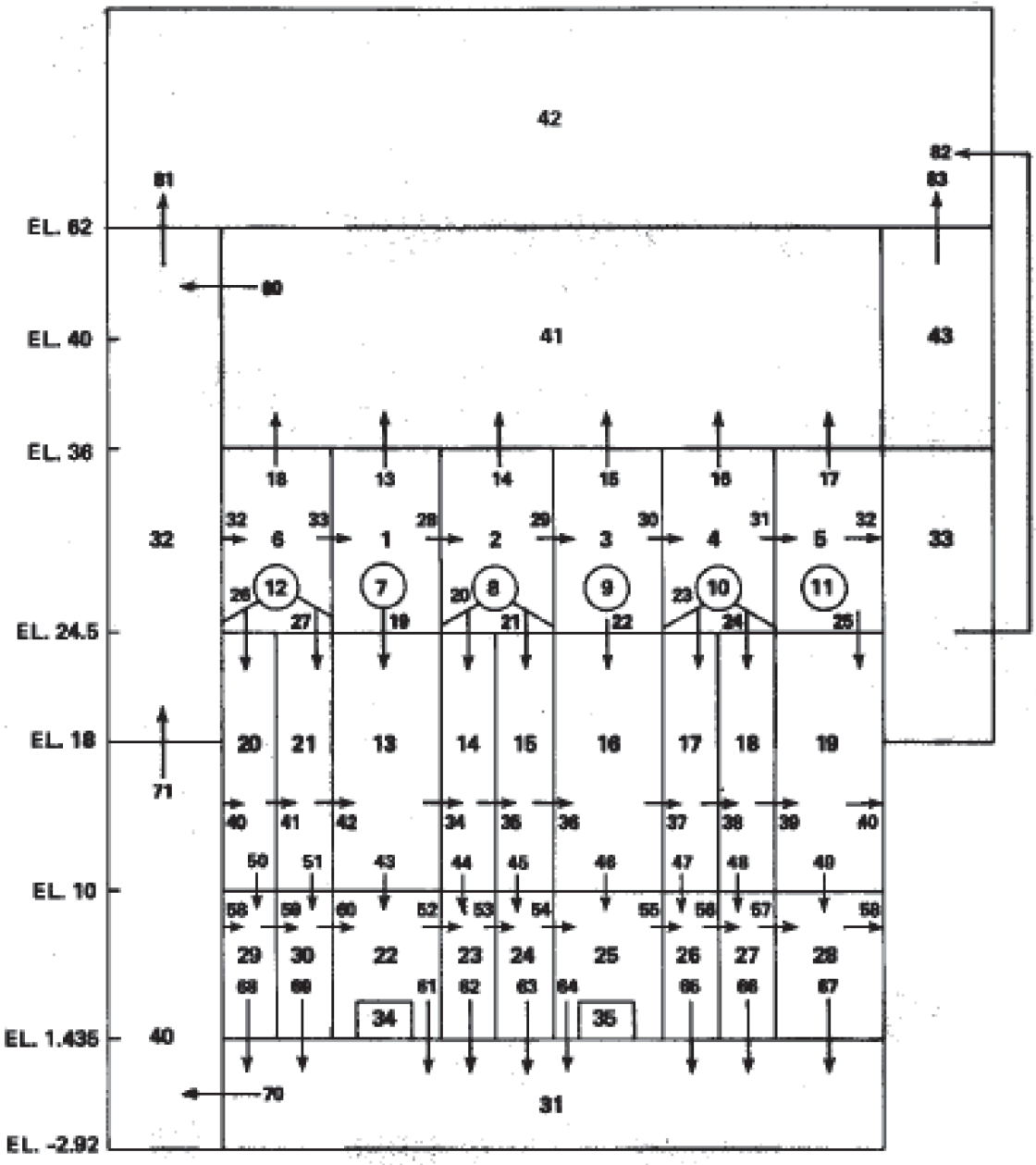
Amendment No. 8, (9/93)

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

FIGURE 6.2-22

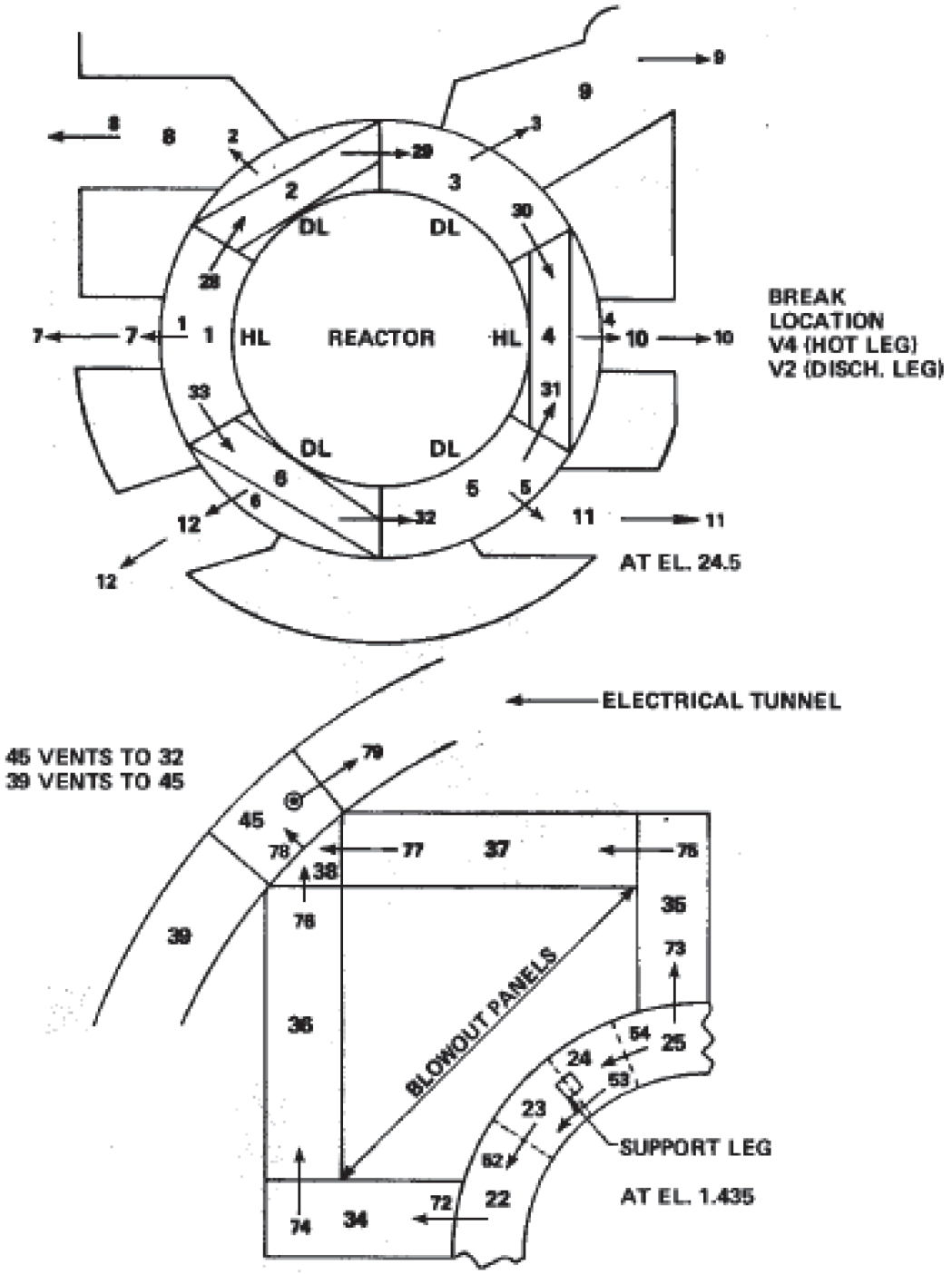


FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

REACTOR CAVITY SUBCOMPARTMENT MODEL SCHEMATIC (SECTION VIEW) (HISTORICAL)

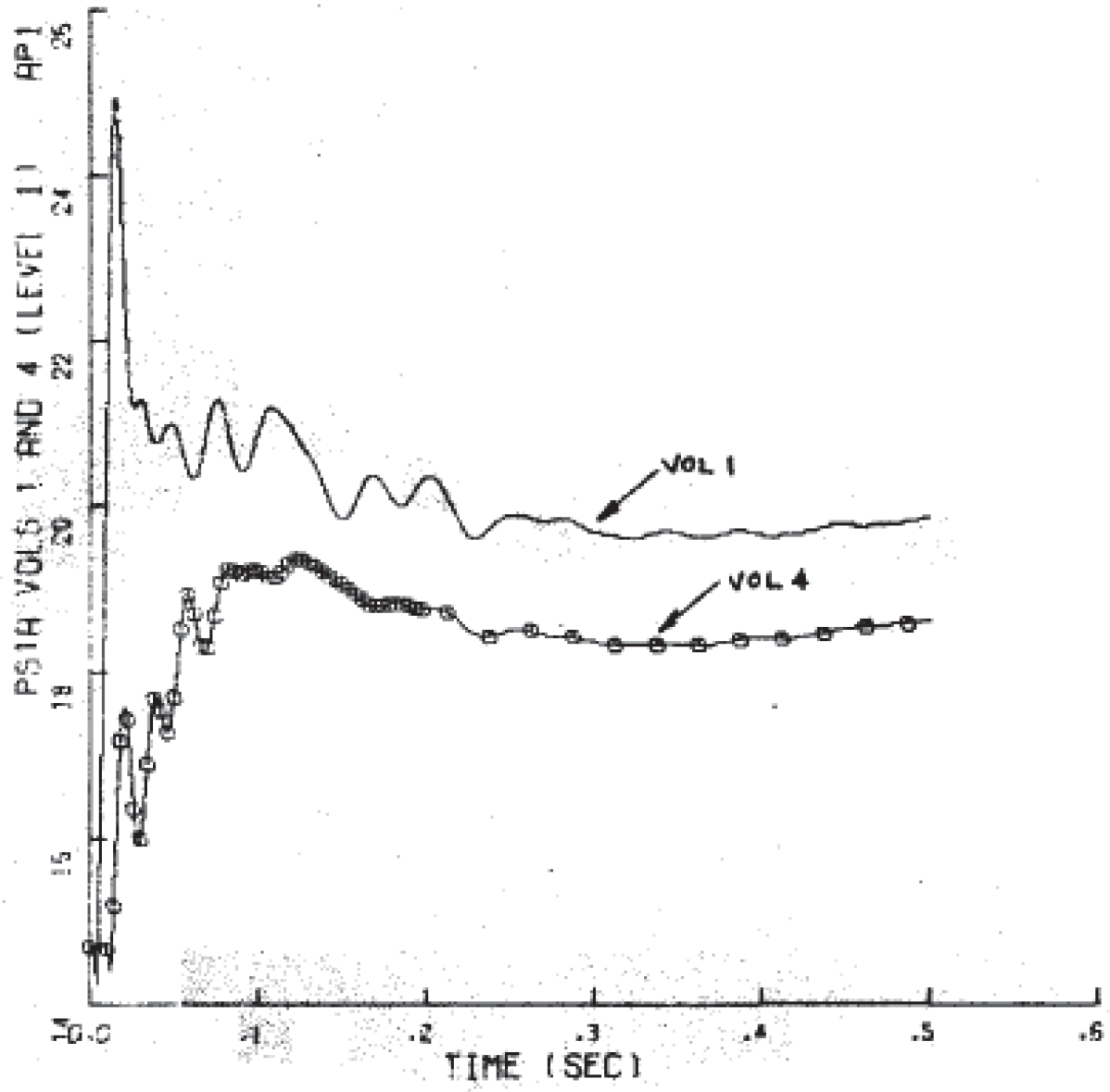
FIGURE 6.2-23

Amendment No. 21 (11/12)



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

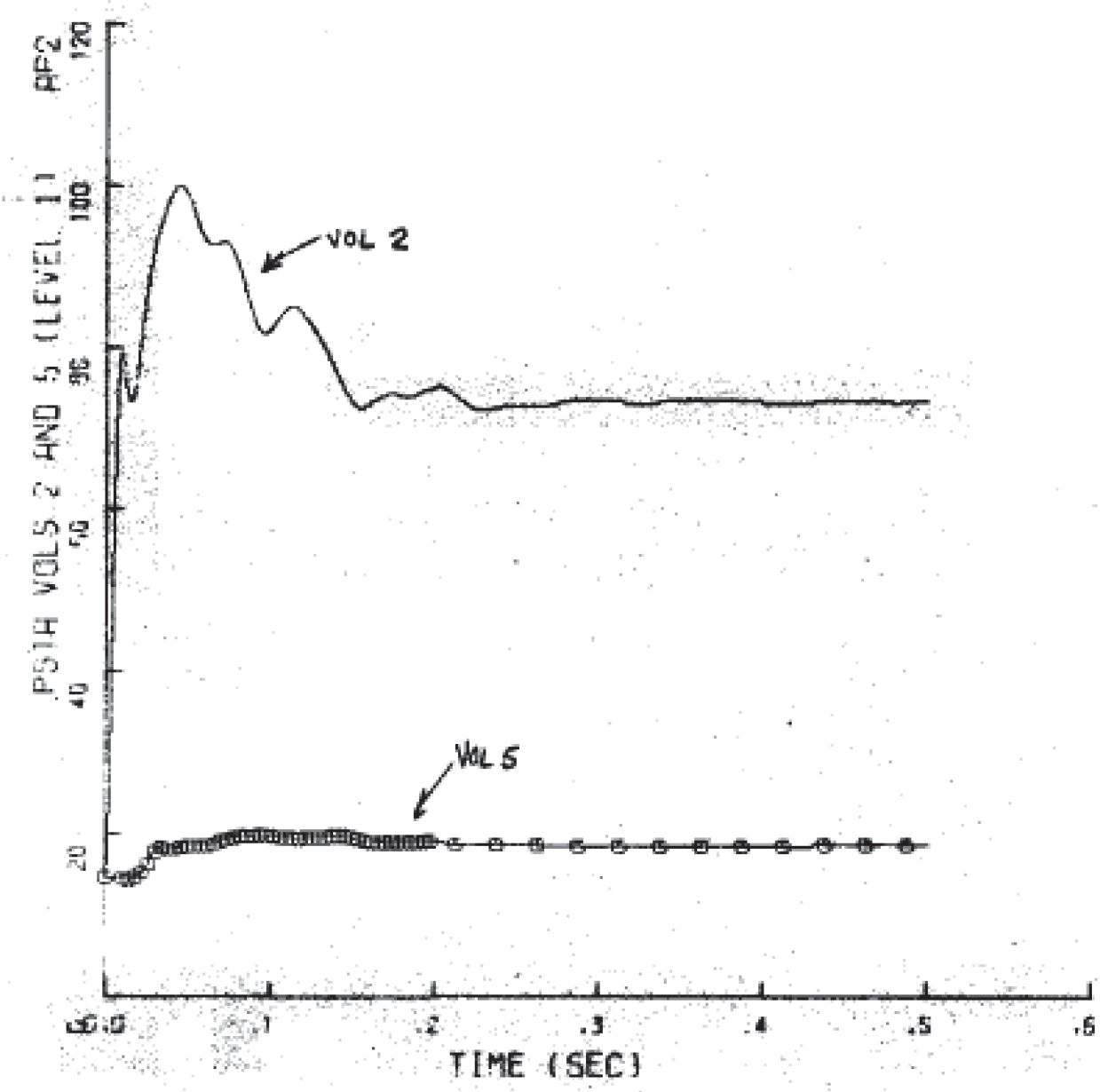
REACTOR CAVITY SUBCOMPARTMENT
MODEL SCHEMATIC (PLAN VIEW)
(HISTORICAL)
FIGURE 6.2-24



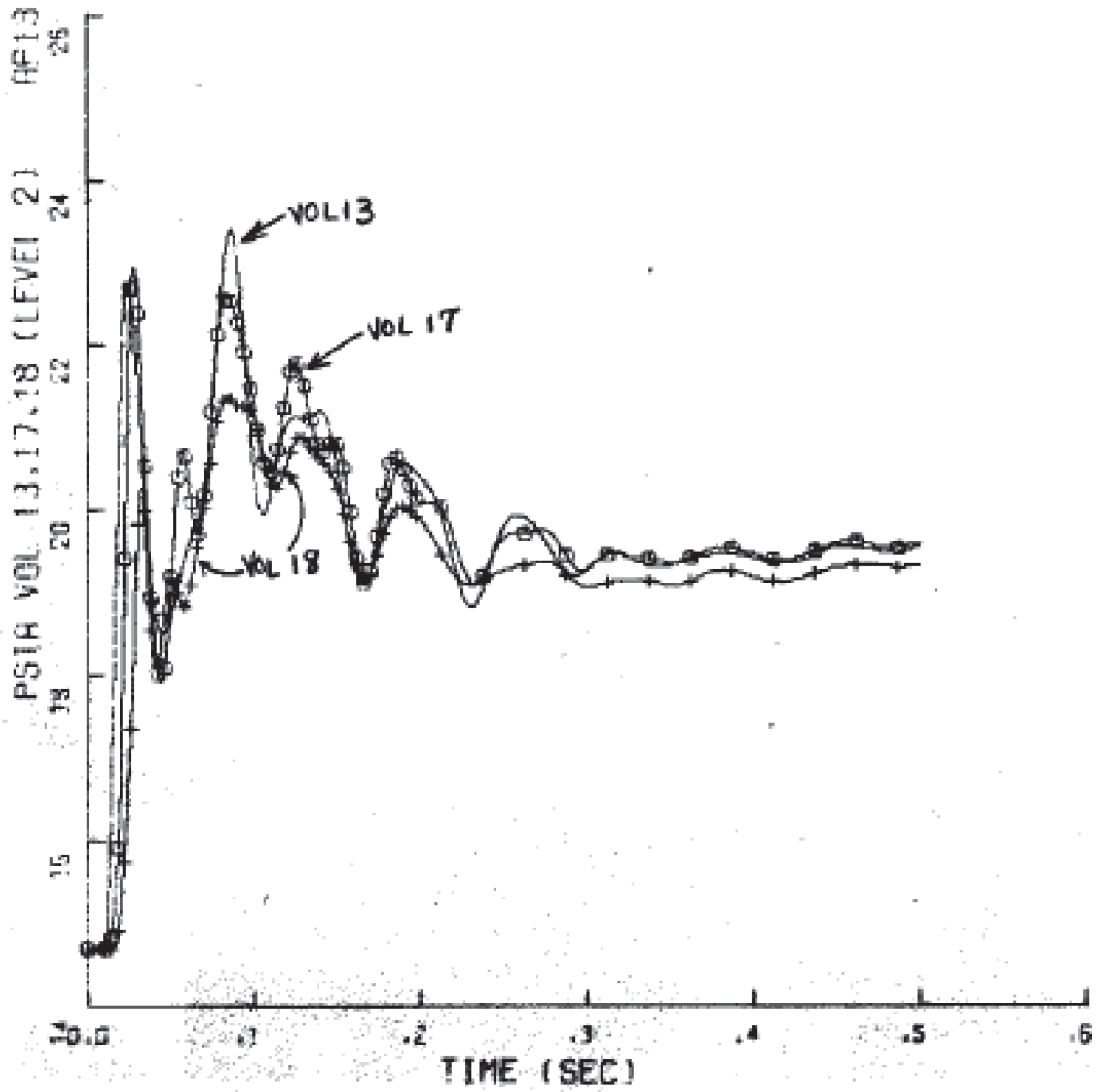
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

REACTOR CAVITY PRESSURE-DISCH. LEG GUILLOTINE BREAK AT REACTOR VESSEL NOZZLE (HISTORICAL)

FIGURE 6.2-25a



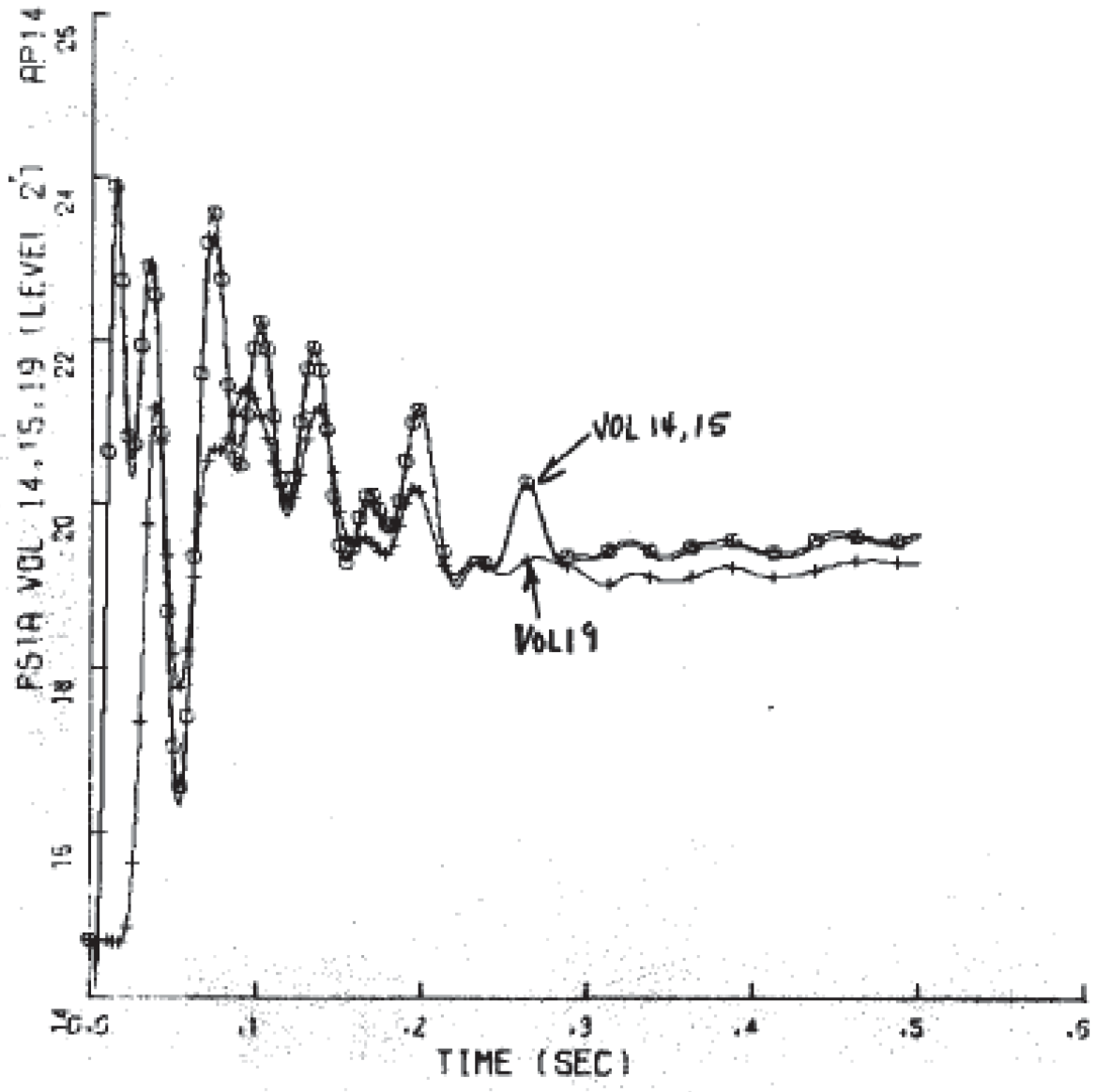
FLORIDA POWER & LIGHT COMPANY **ST. LUCIE PLANT UNIT 2**
REACTOR CAVITY PRESSURE – DISCH. LEG GUILLOTINE BREAK AT REACTOR VESSEL NOZZLE (HISTORICAL) **FIGURE 6.2-25b**



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

REACTOR CAVITY PRESSURE – DISCH. LEG GUILLOTINE BREAK AT REACTOR VESSEL NOZZLE (HISTORICAL)

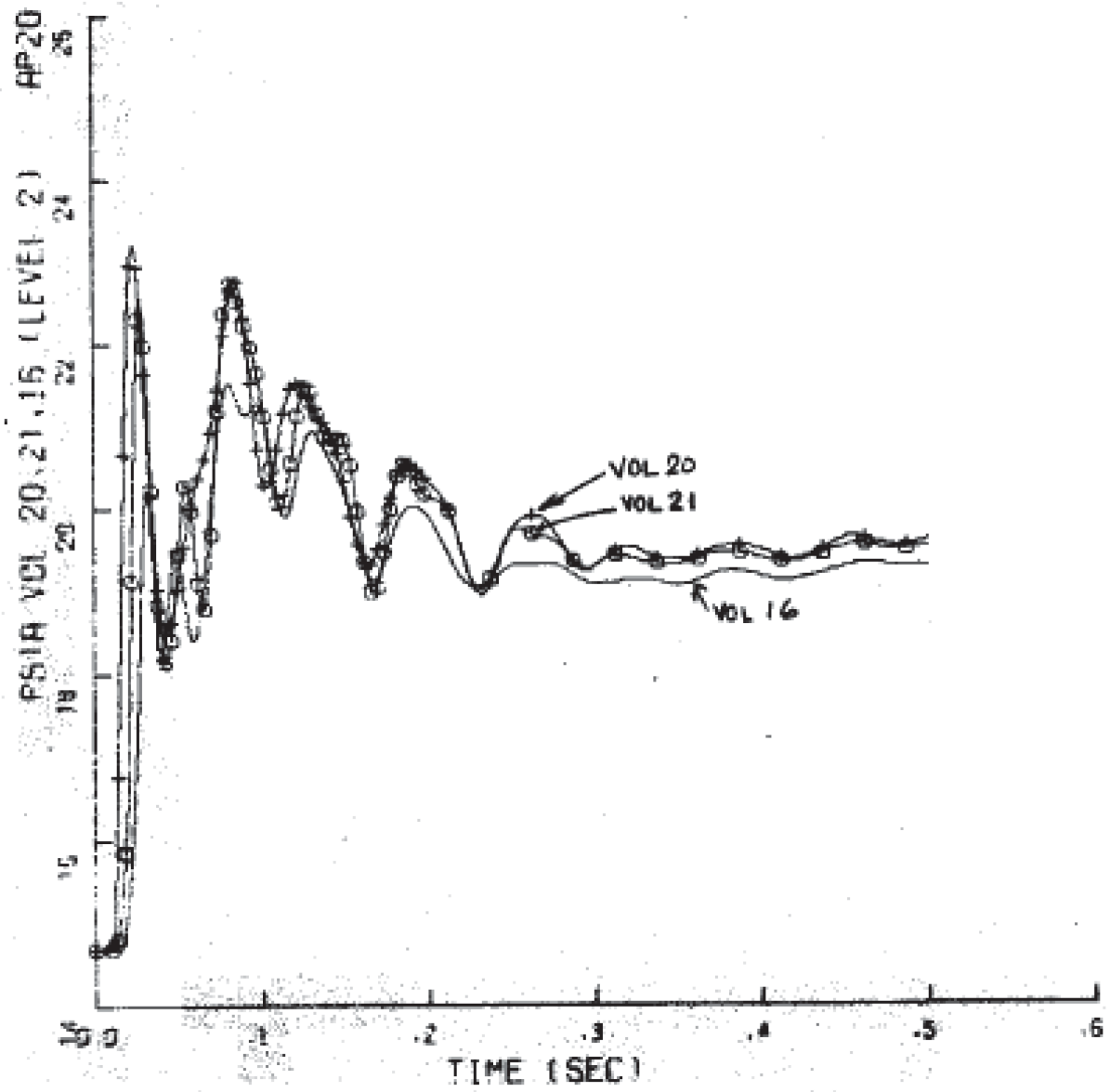
FIGURE 6.2-25c



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

REACTOR CAVITY PRESSURE – DISCH. LEG GUILLOTINE BREAK AT REACTOR VESSEL NOZZLE (HISTORICAL)

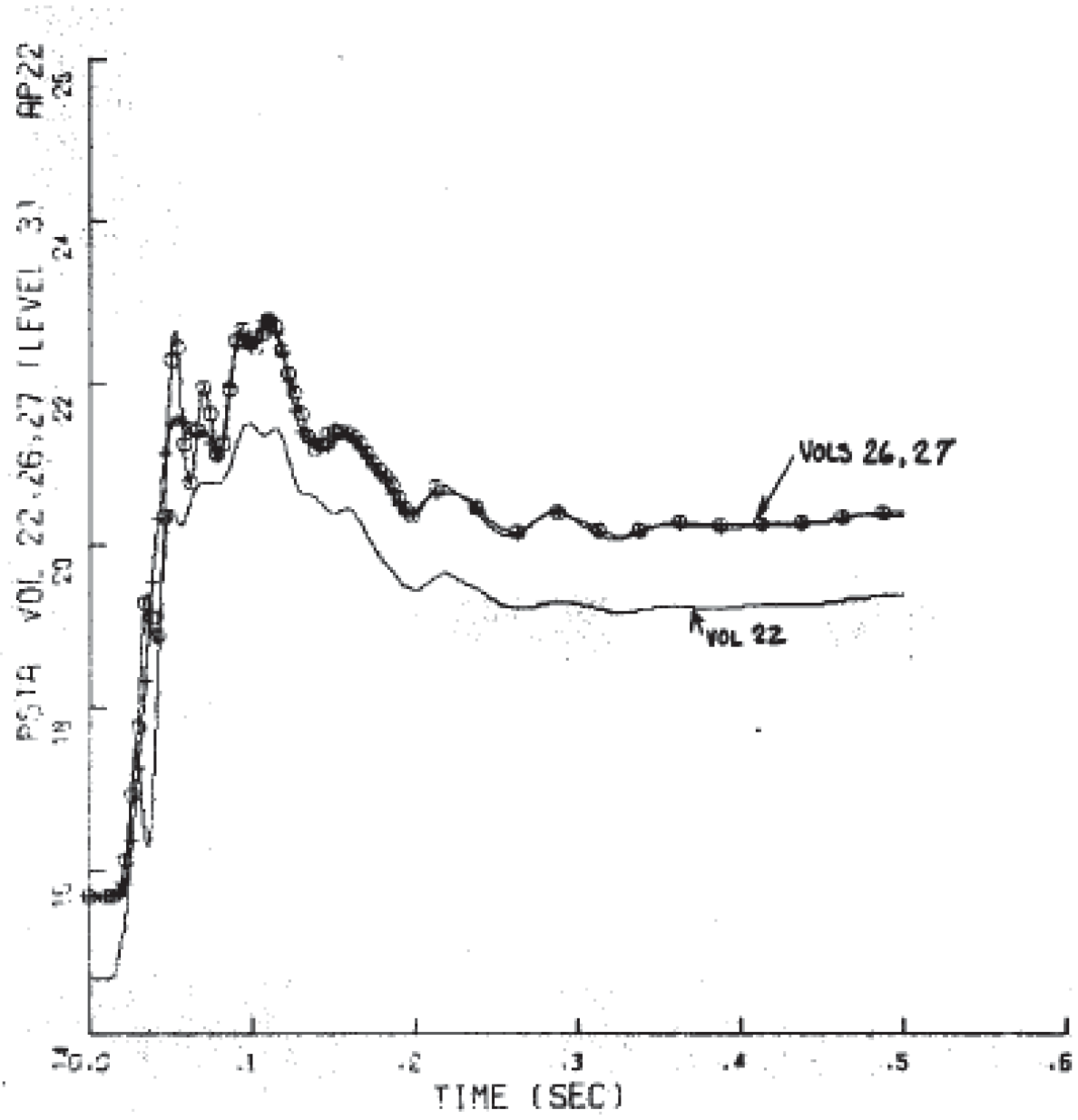
FIGURE 6.2-25d



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

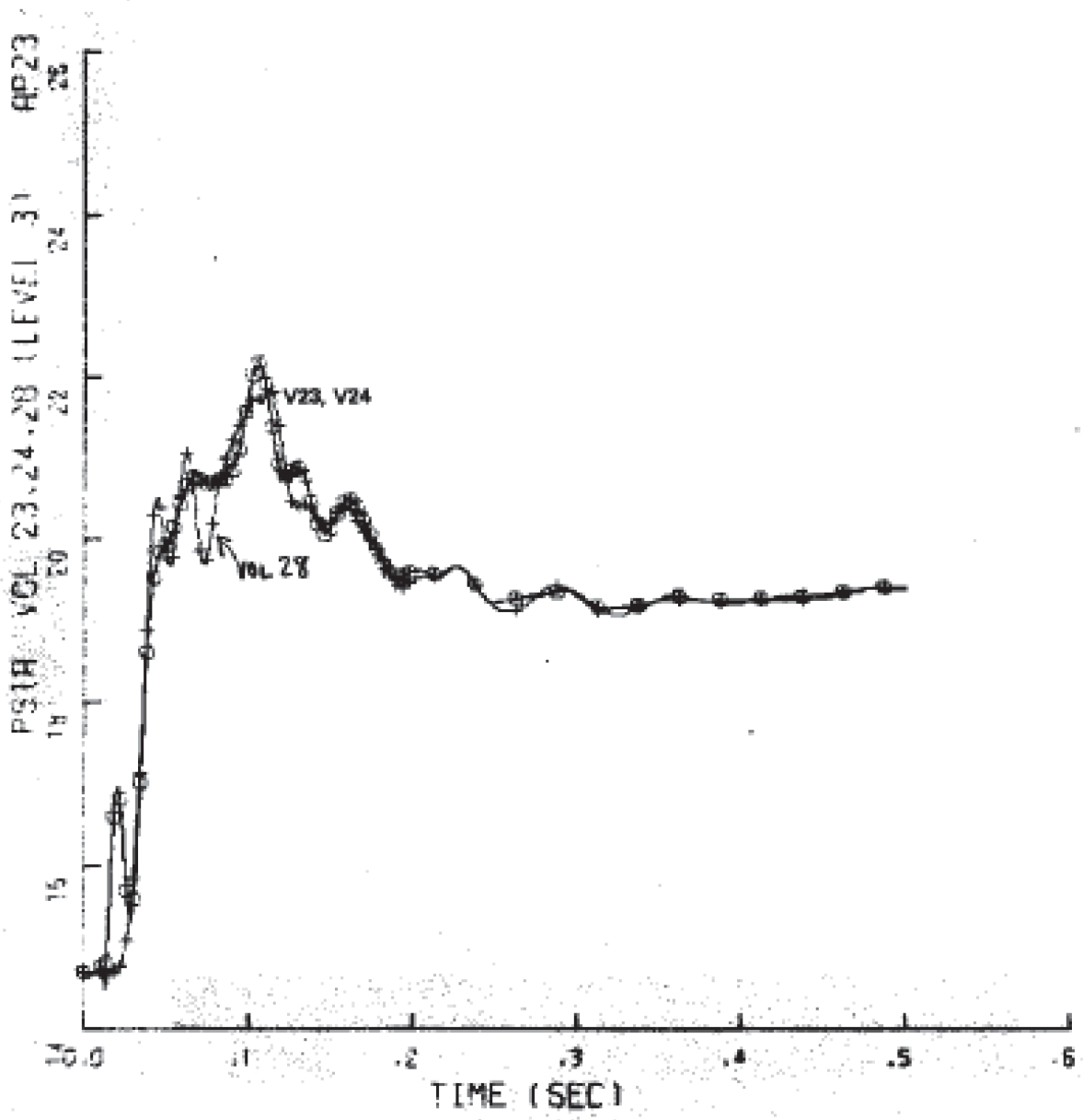
REACTOR CAVITY PRESSURE – DISCH. LEG GUILLOTINE BREAK AT REACTOR VESSEL NOZZLE (HISTORICAL)

FIGURE 6.2-25e



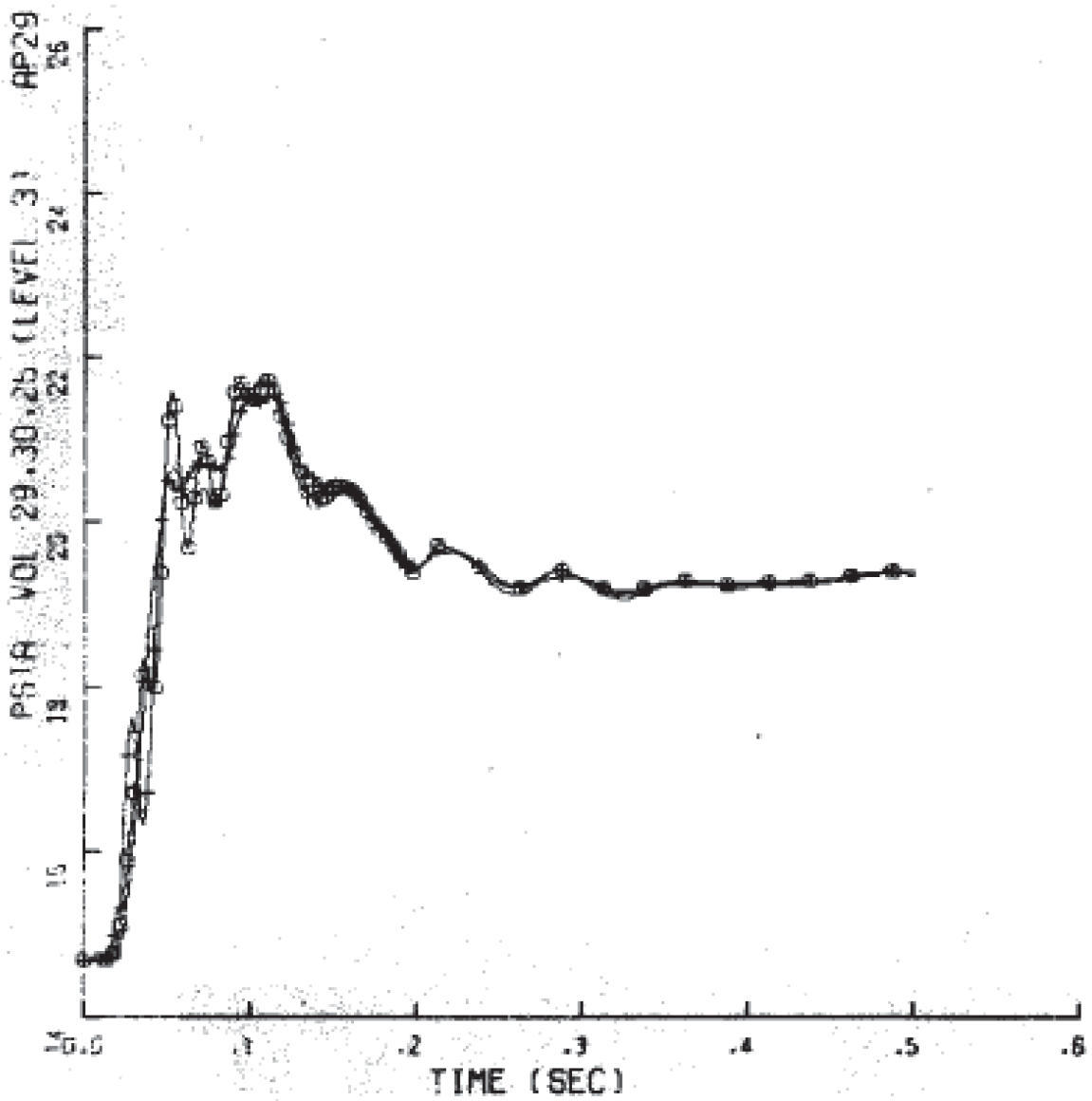
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

REACTOR CAVITY PRESSURE – DISCH. LEG GUILLOTINE BREAK AT REACTOR VESSEL NOZZLE (HISTORICAL)
FIGURE 6.2-25f



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

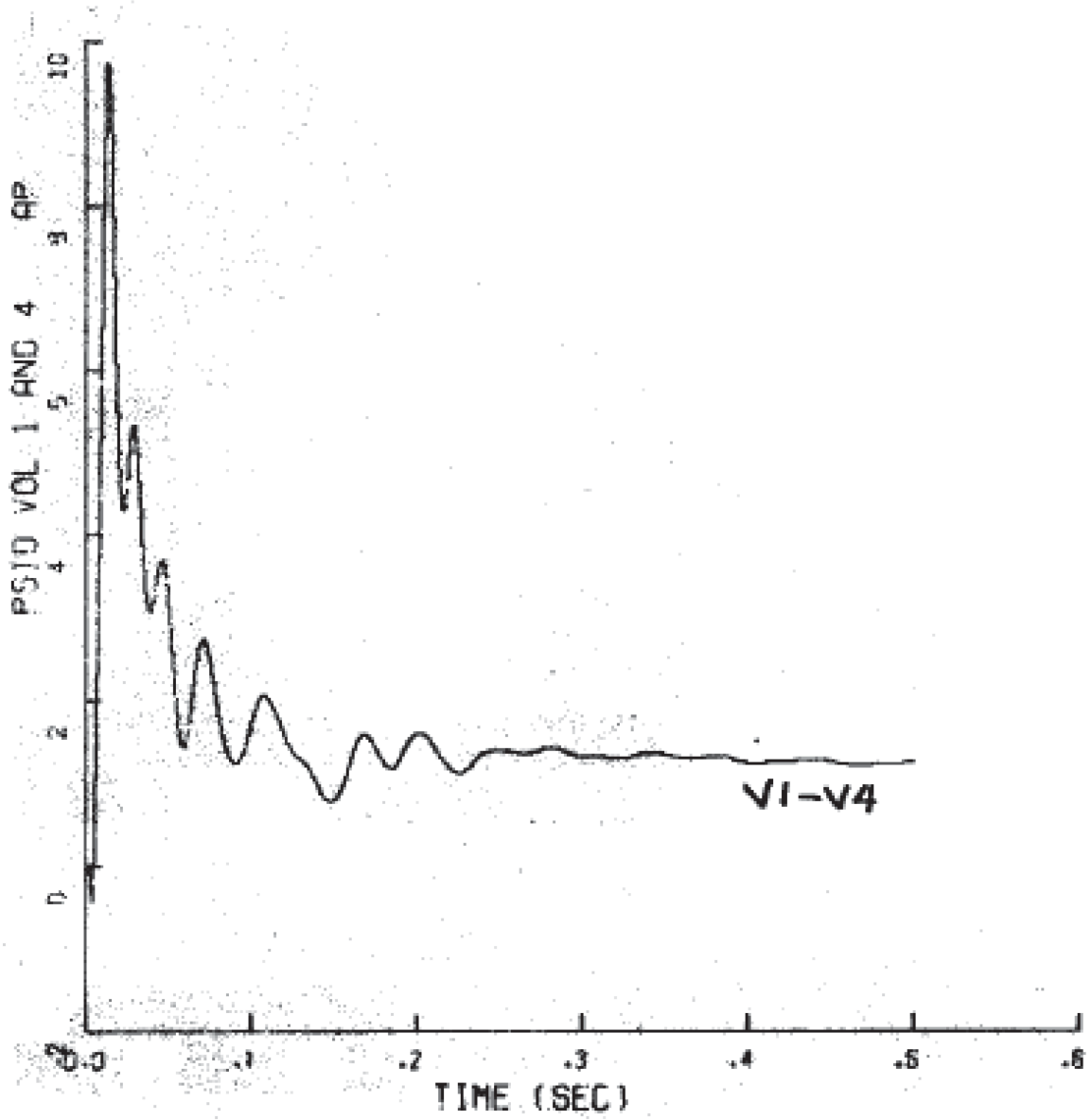
REACTOR CAVITY PRESSURE – DISCH. LEG GUILLOTINE BREAK AT REACTOR VESSEL NOZZLE (HISTORICAL)
FIGURE 6.2-25g



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

REACTOR CAVITY PRESSURE – DISCH. LEG GUILLOTINE BREAK AT REACTOR VESSEL NOZZLE (HISTORICAL)

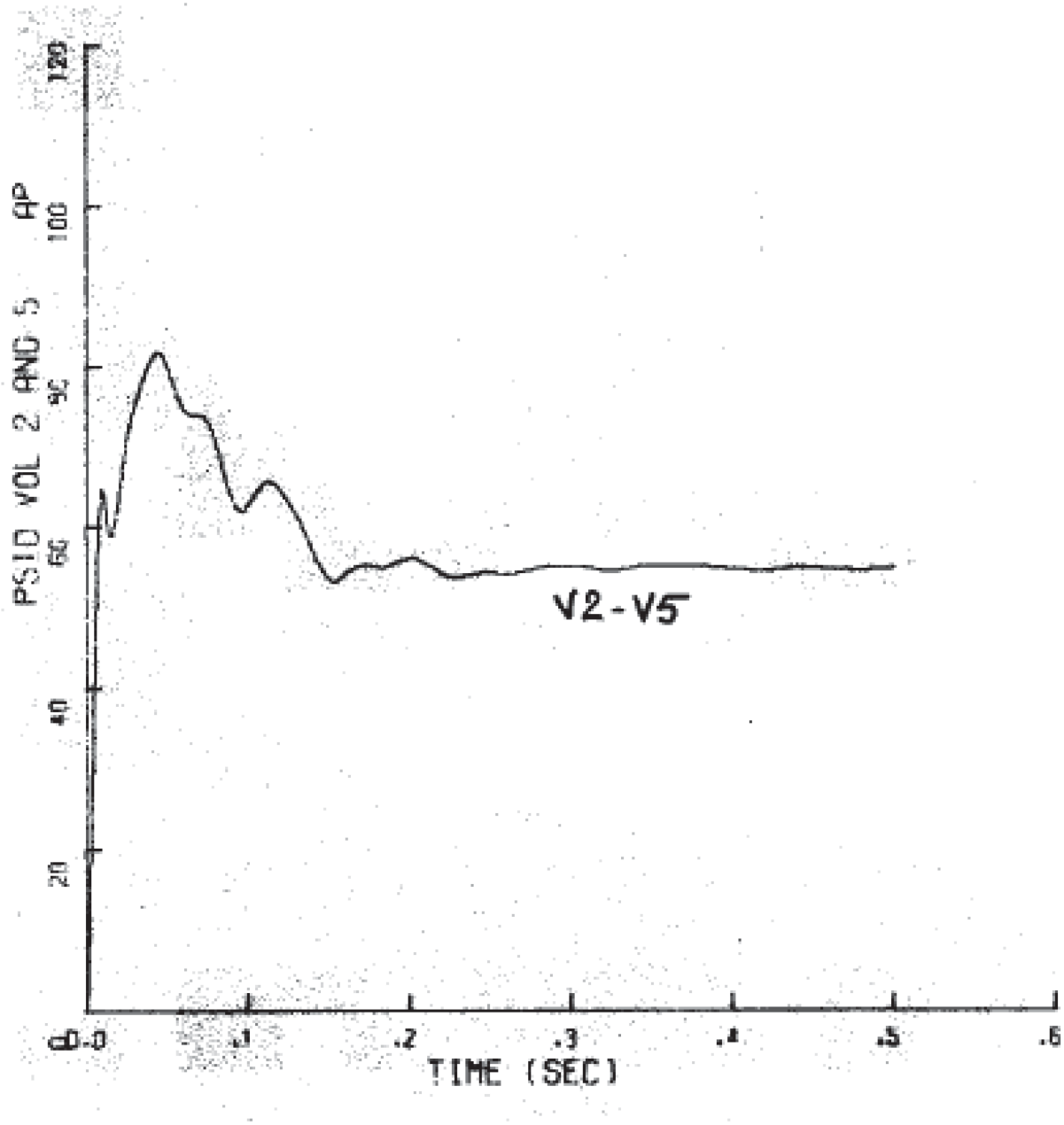
FIGURE 6.2-25h



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

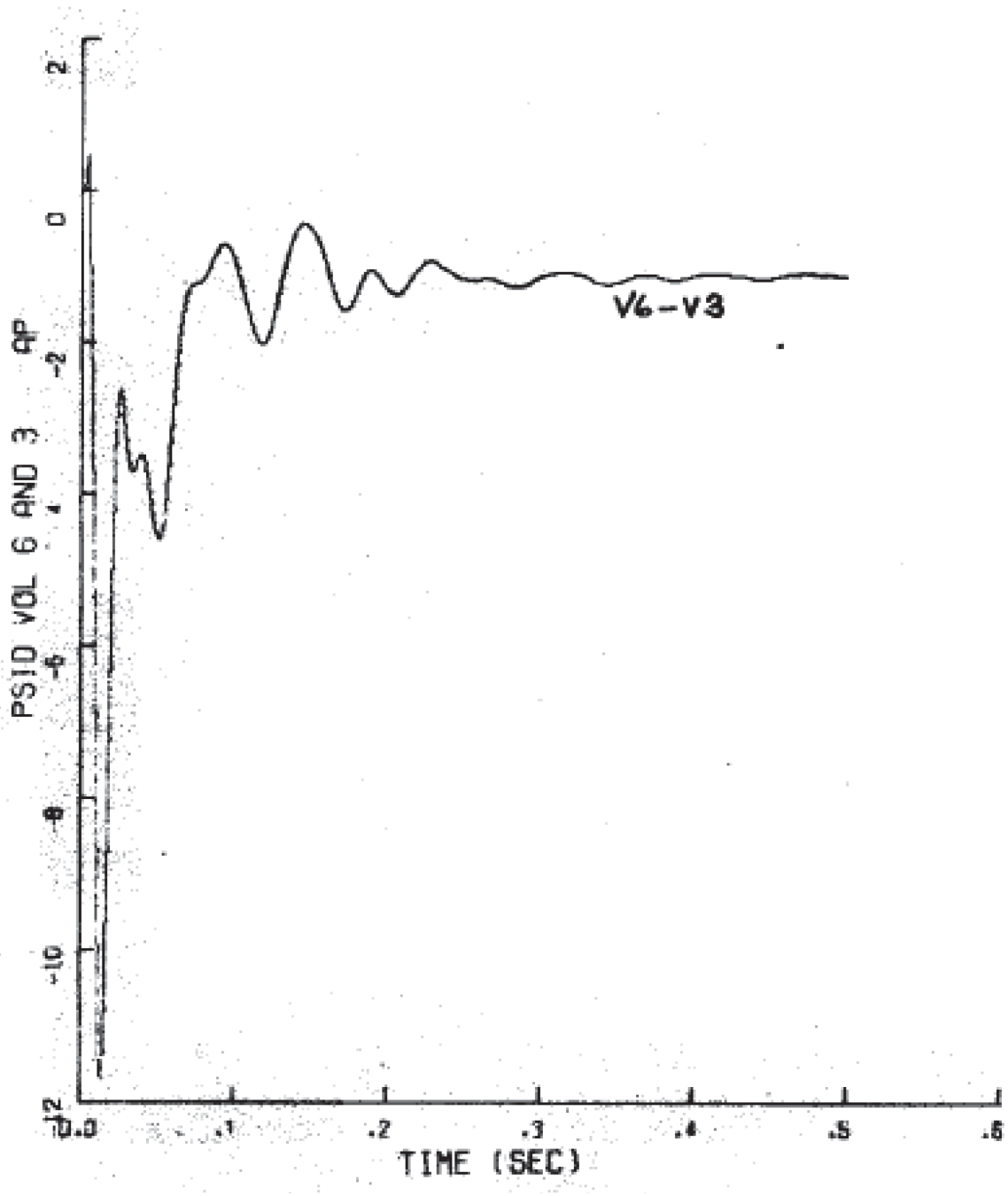
REACTOR CAVITY PRESSURE – DISCH. LEG GUILLOTINE BREAK AT REACTOR VESSEL NOZZLE (HISTORICAL)
FIGURE 6.2-25i

Amendment No. 21 (11/12)



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

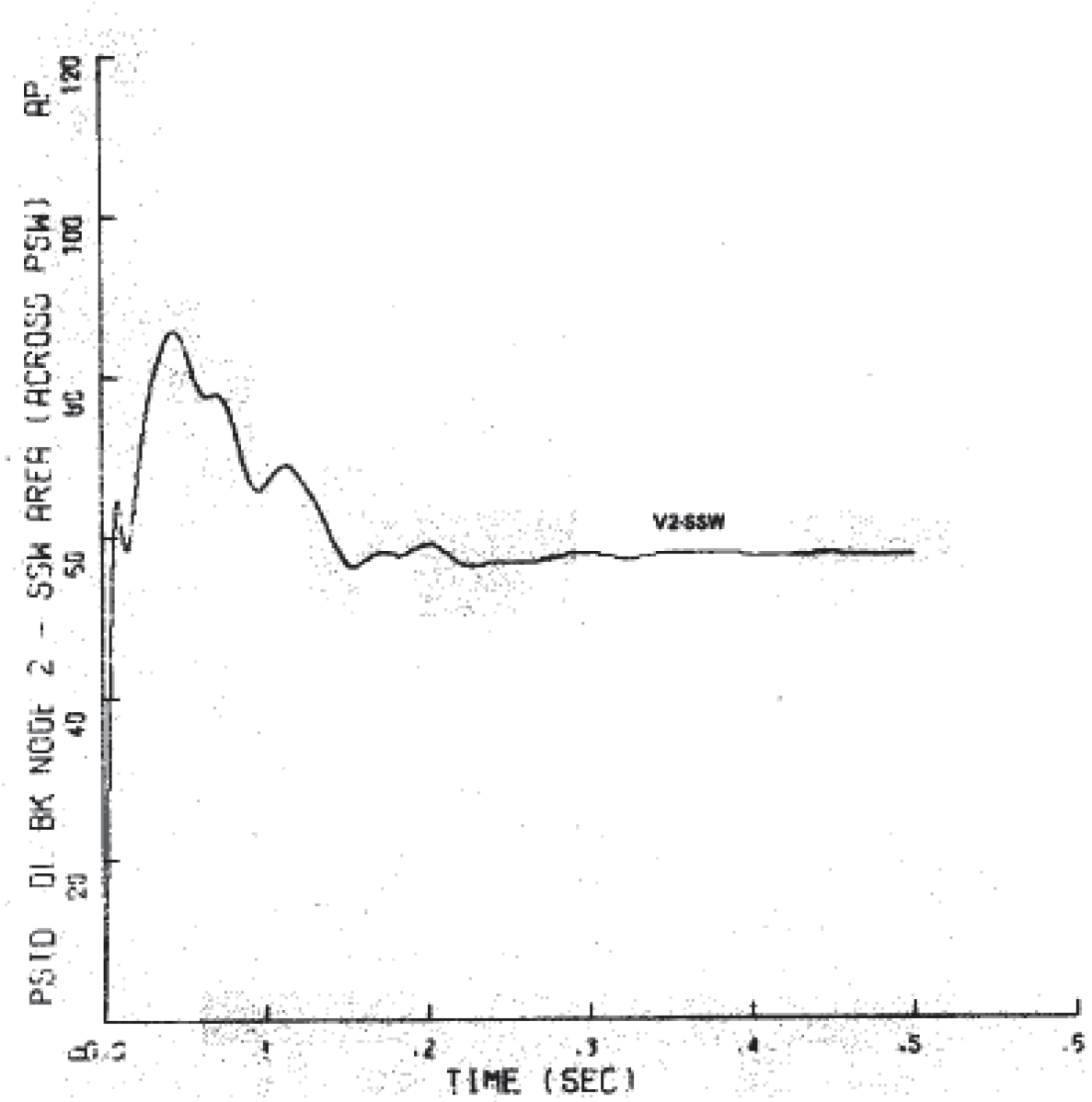
REACTOR CAVITY PRESSURE – DISCH. LEG GUILLOTINE BREAK AT REACTOR VESSEL NOZZLE
(HISTORICAL)
FIGURE 6.2-25j



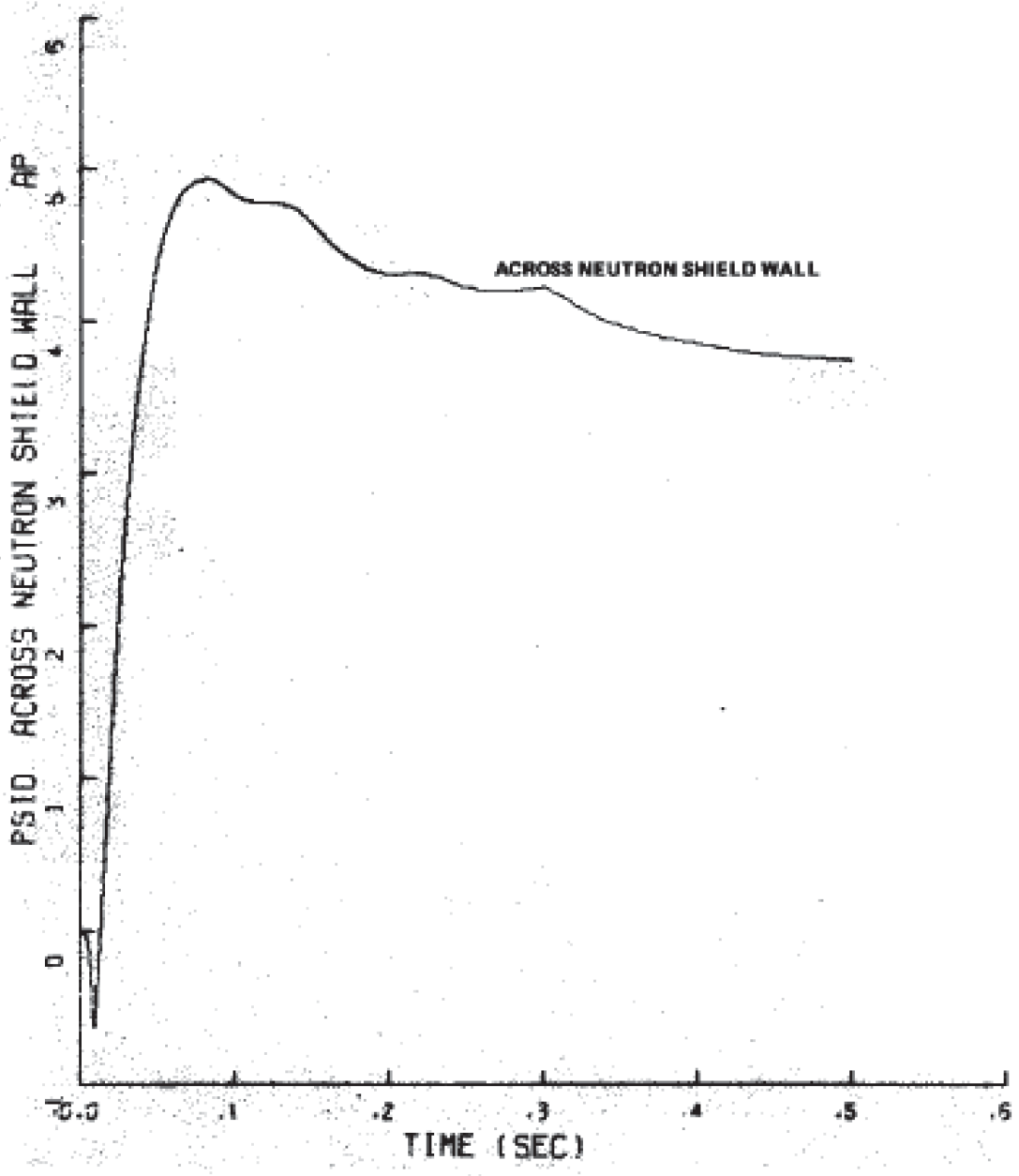
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

REACTOR CAVITY PRESSURE – DISCH. LEG GUILLOTINE BREAK AT REACTOR VESSEL NOZZLE (HISTORICAL)

FIGURE 6.2-25k



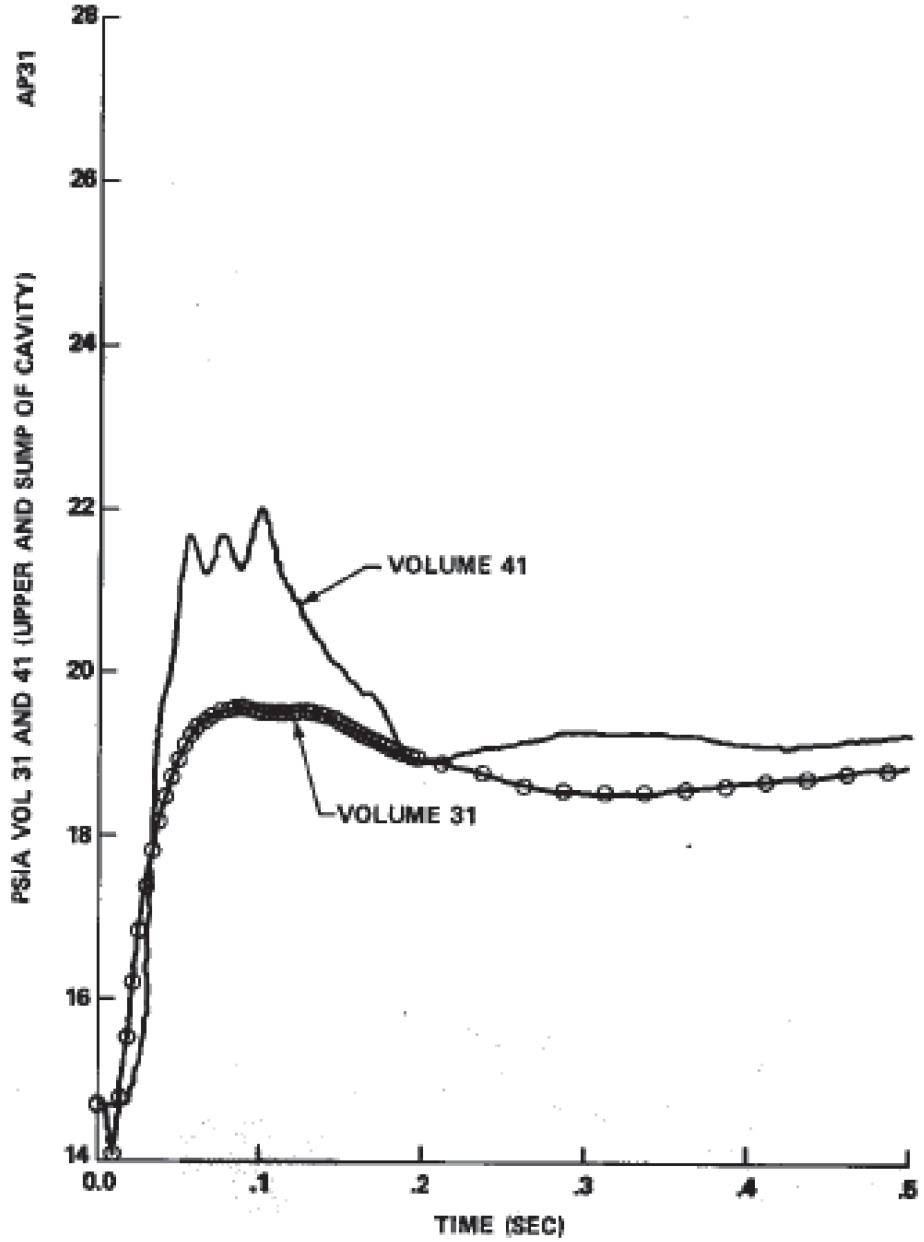
FLORIDA POWER & LIGHT COMPANY **ST. LUCIE PLANT UNIT 2**
REACTOR CAVITY PRESSURE – DISCH. LEG GUILLOTINE BREAK AT REACTOR VESSEL NOZZLE (HISTORICAL) **FIGURE 6.2-25I**



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

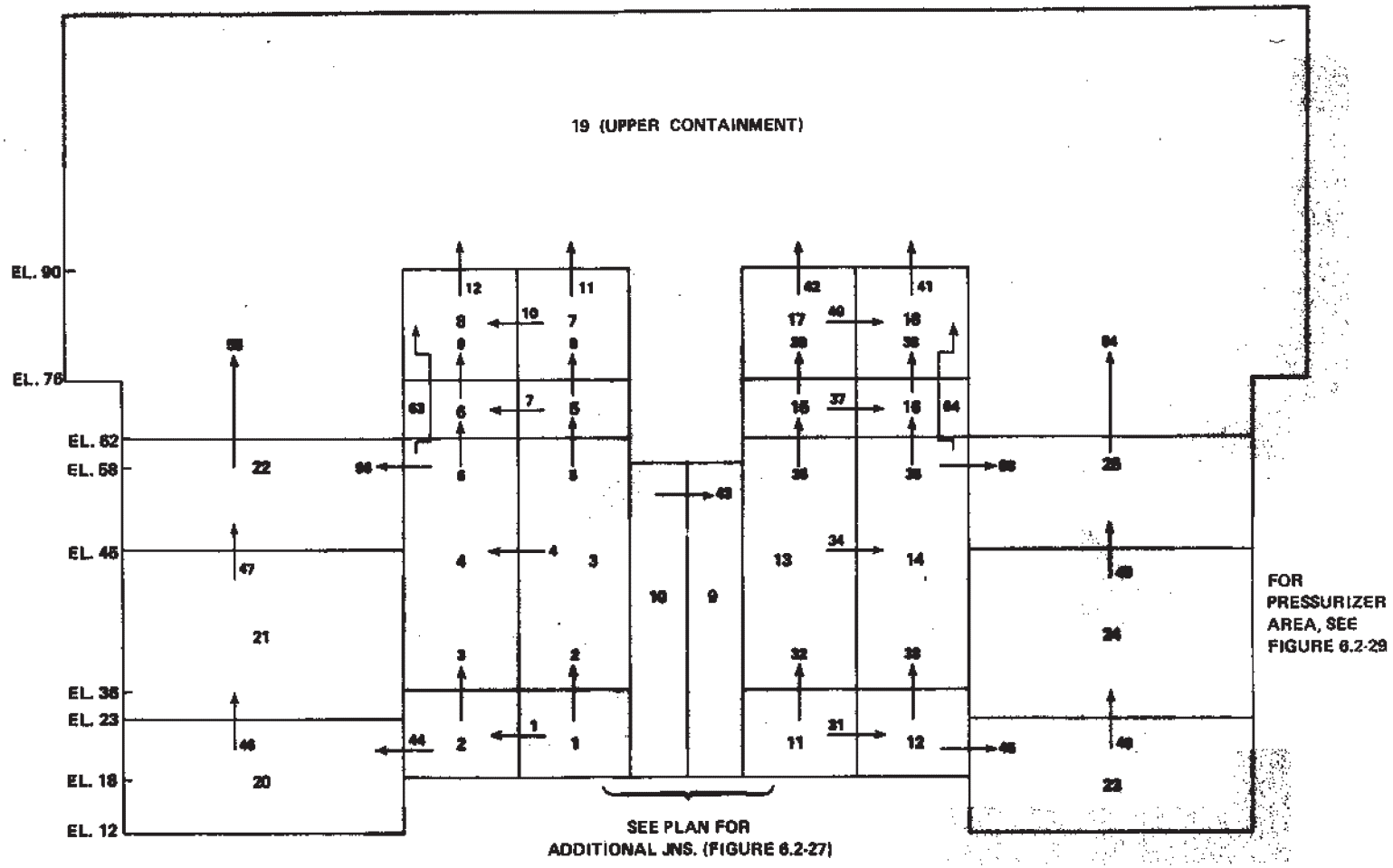
REACTOR CAVITY PRESSURE – DISCH. LEG GUILLOTINE BREAK AT REACTOR VESSEL NOZZLE (HISTORICAL)

FIGURE 6.2-25m



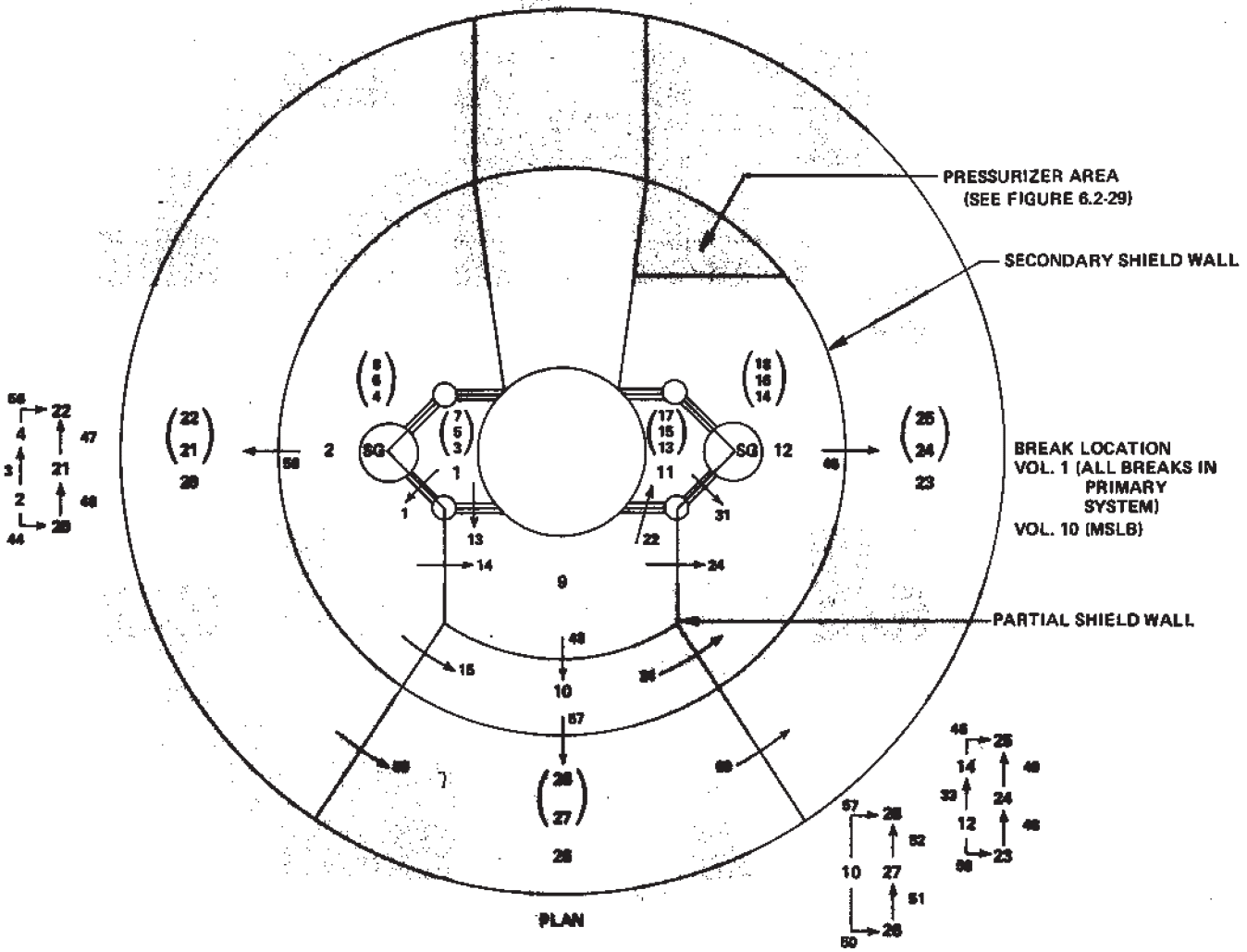
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

REACTOR CAVITY PRESSURE – DISCH. LEG GUILLOTINE BREAK AT REACTOR VESSEL NOZZLE
(HISTORICAL)
FIGURE 6.2-25n



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

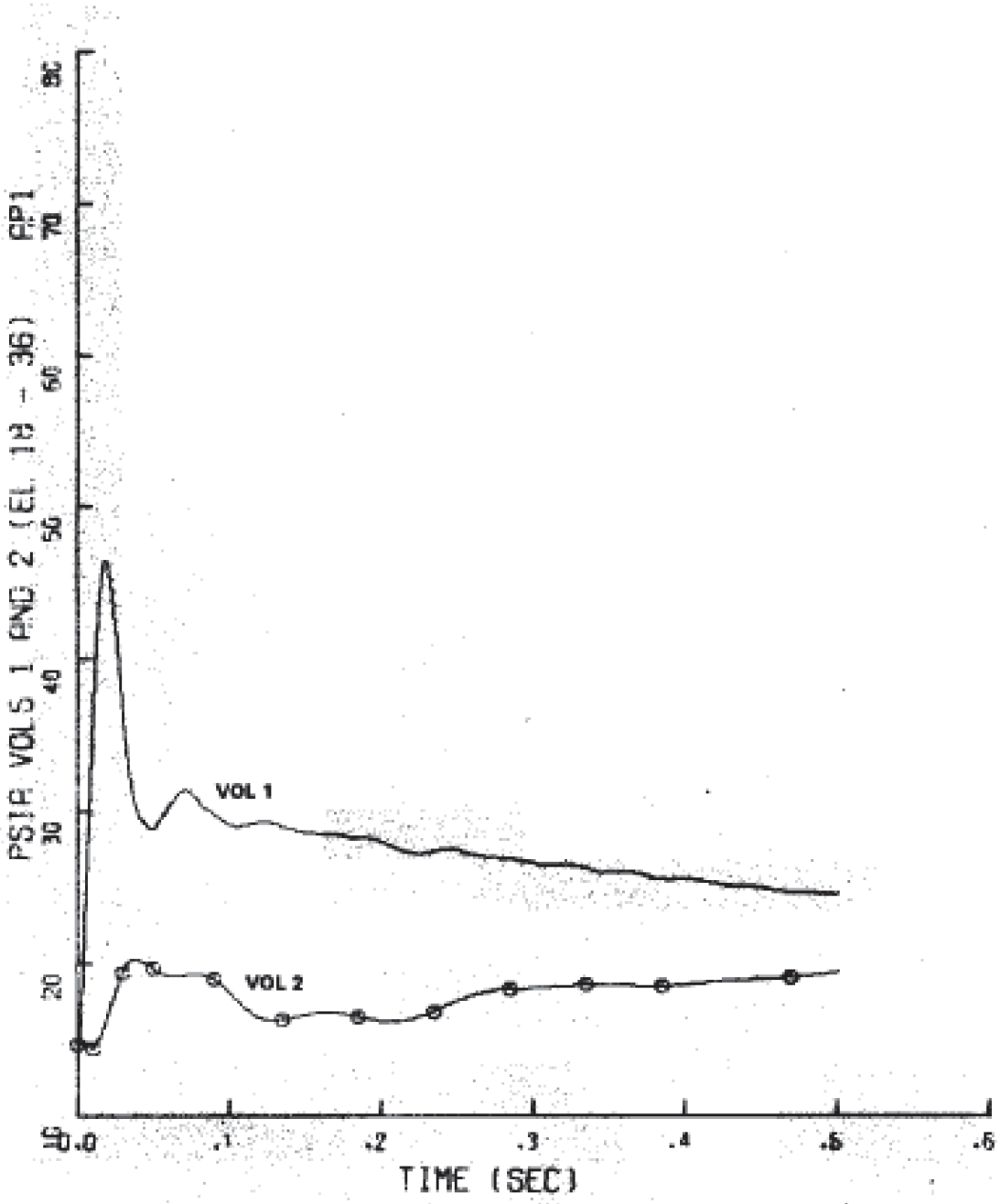
SECONDARY SHIELD WALL AREA
SUBCOMPARTMENTS – MODEL
SCHEMATIC (SECTIONAL VIEW)
FIGURE 6.2-26



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

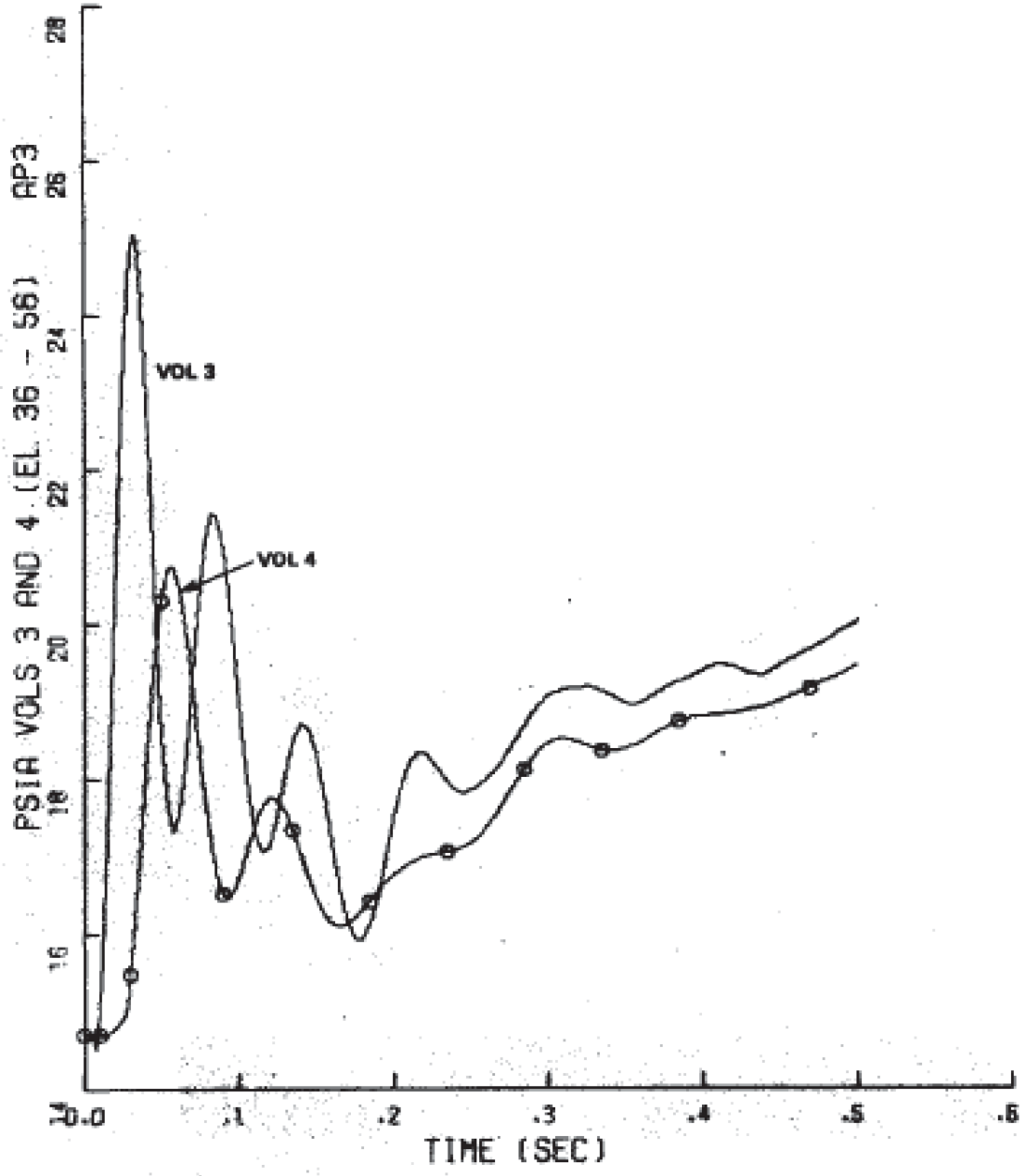
SECONDARY SHIELD WALL AREA SUBCOMPARTMENTS – MODEL SCHEMATIC (PLAN VIEW)

FIGURE 6.2-27



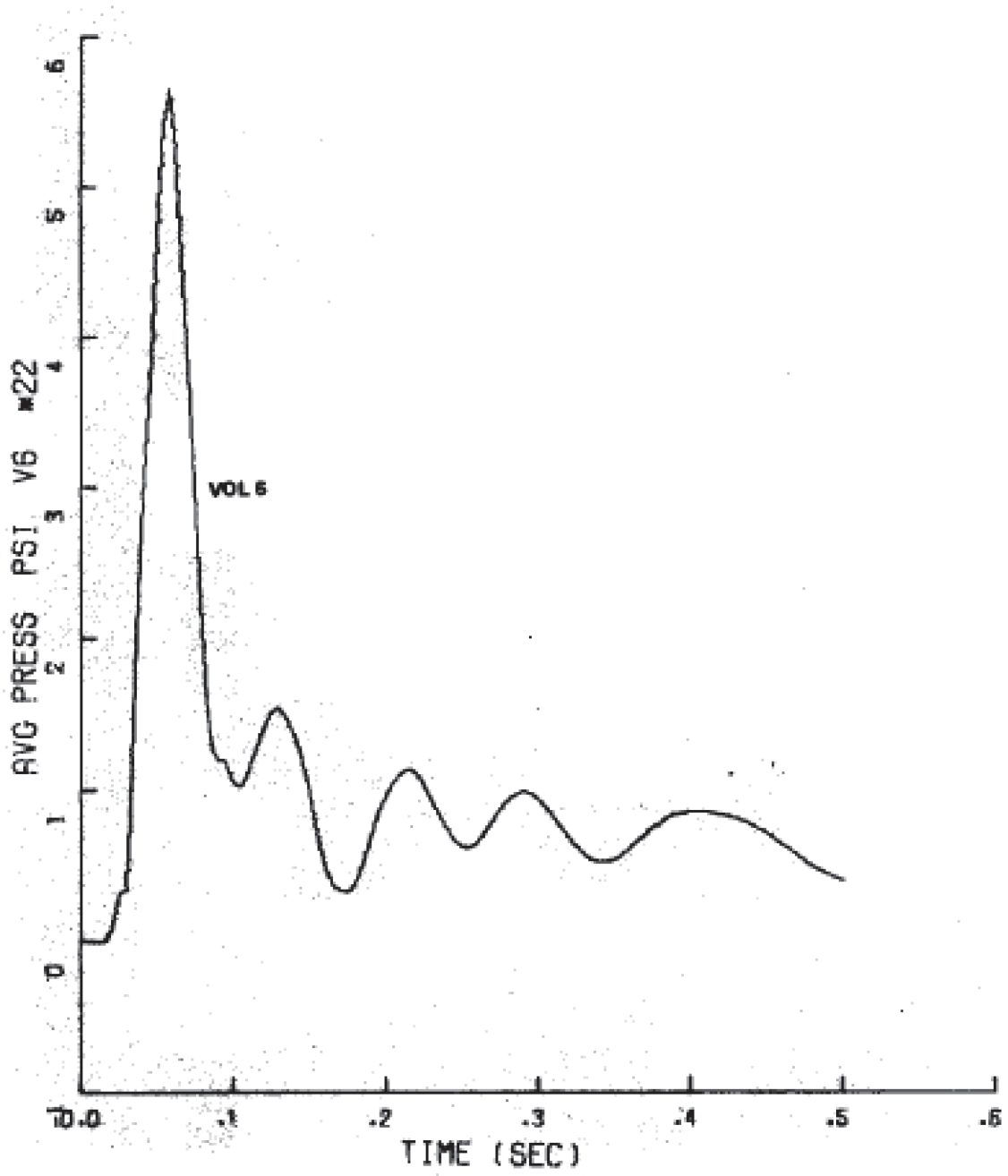
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL)
FIGURE 6.2-28a



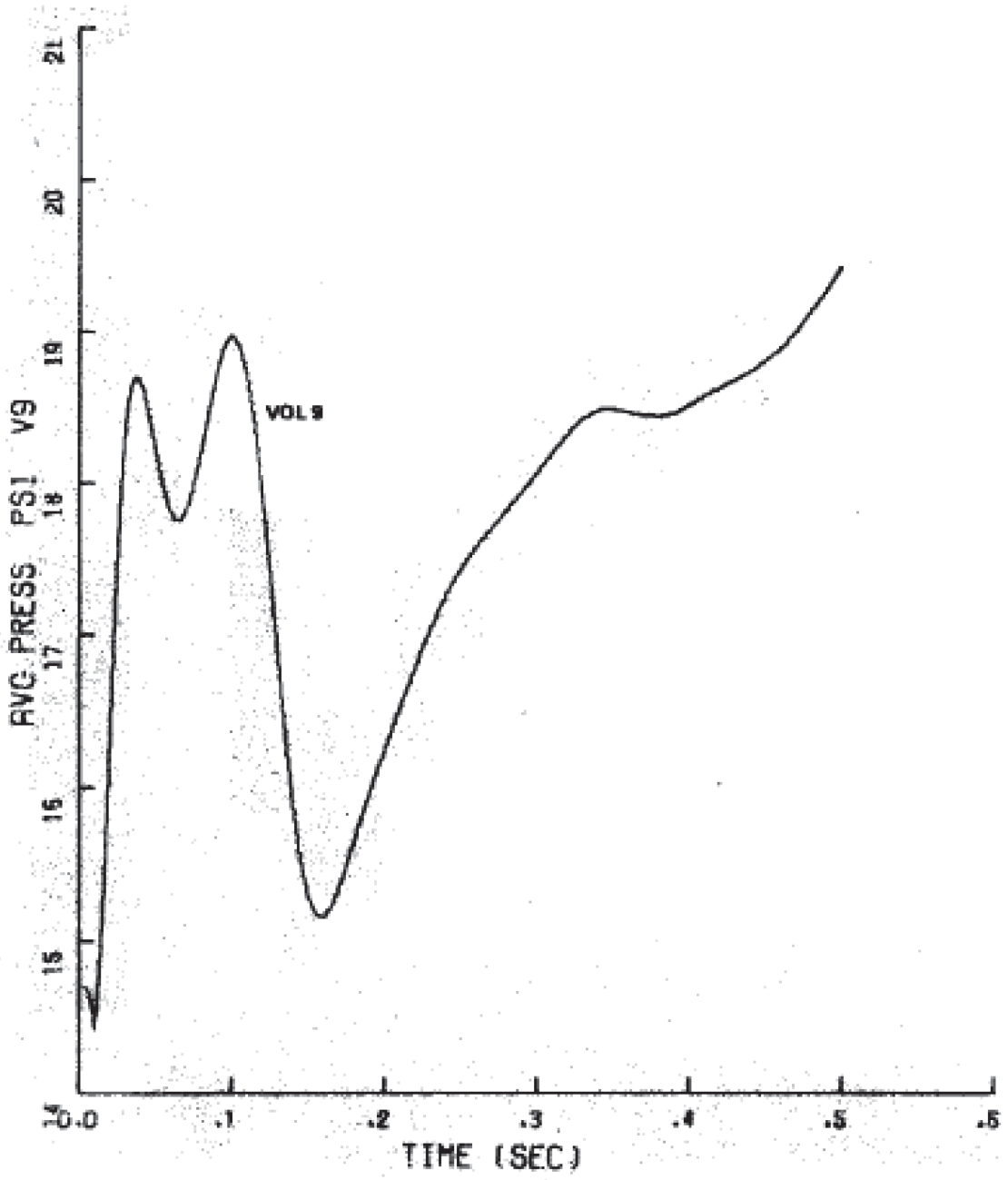
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL)
FIGURE 6.2-28b



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL)
FIGURE 6.2-28c

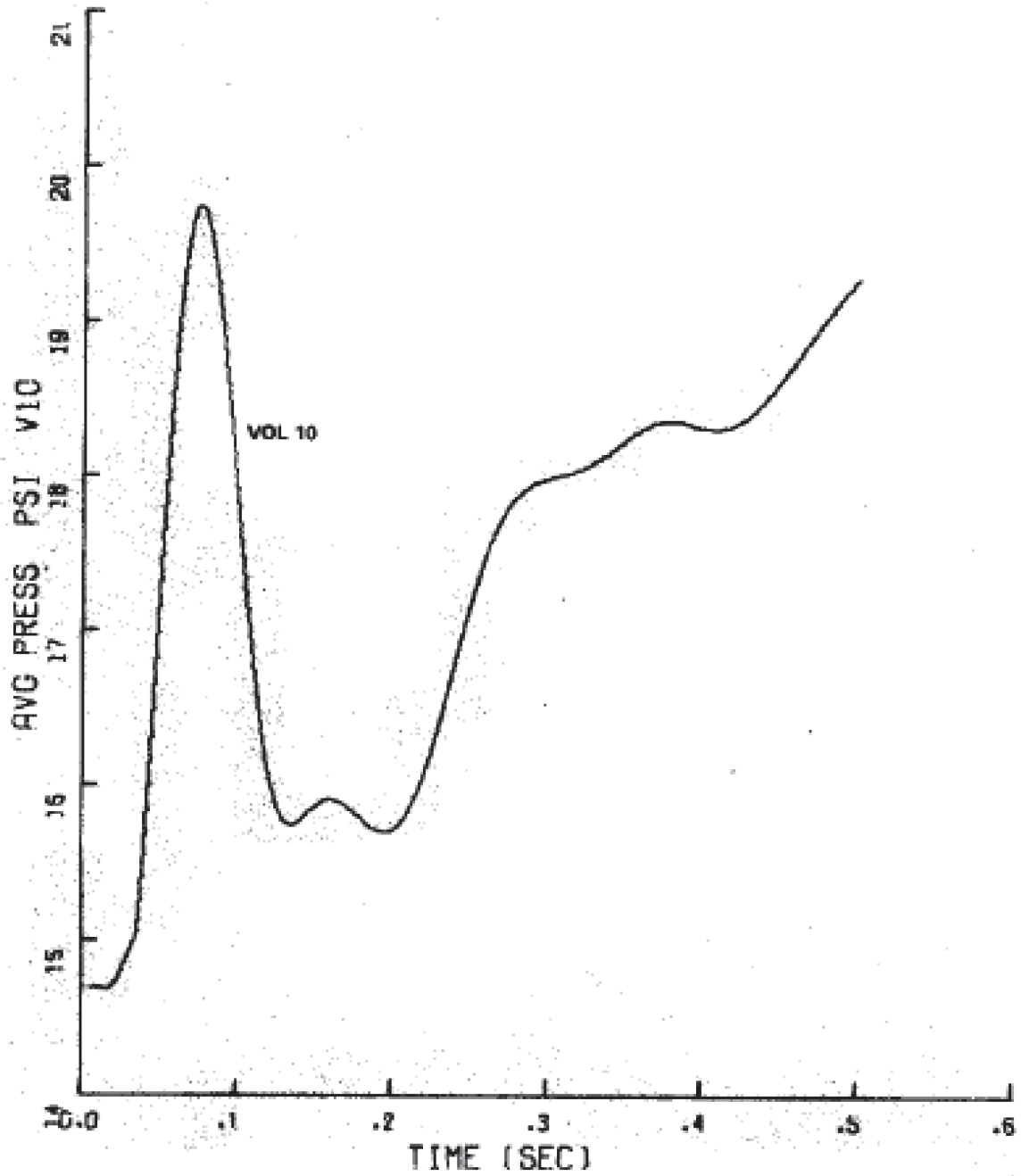


FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SECONDARY SHIELD WALL AREA PRESSURE – SUCTION LEG GUILLOTINE BREAK AT S.G. NOZZLE (HISTORICAL)

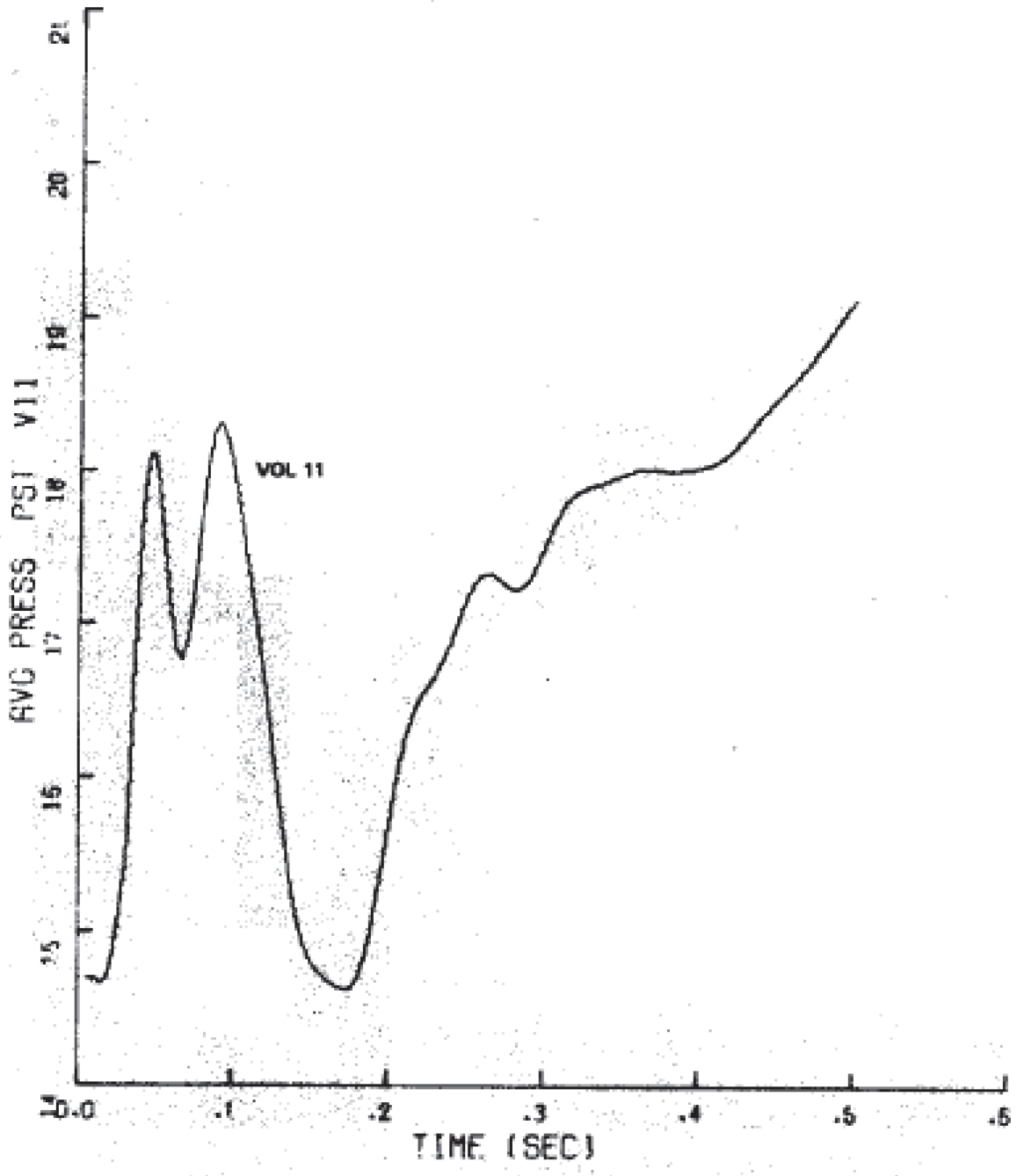
FIGURE 6.2-28d

Amendment No. 21 (11/12)



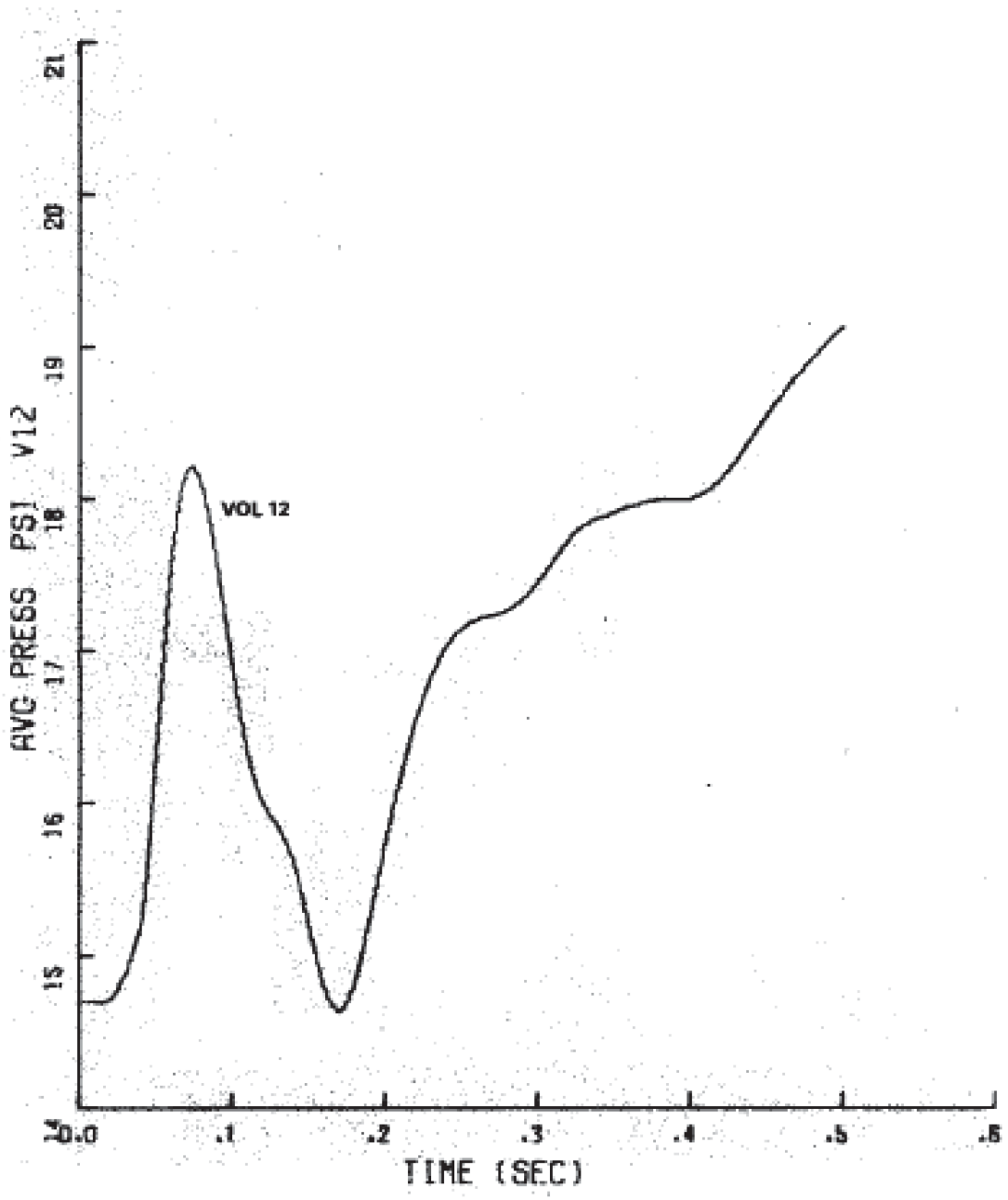
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL)
FIGURE 6.2-28e



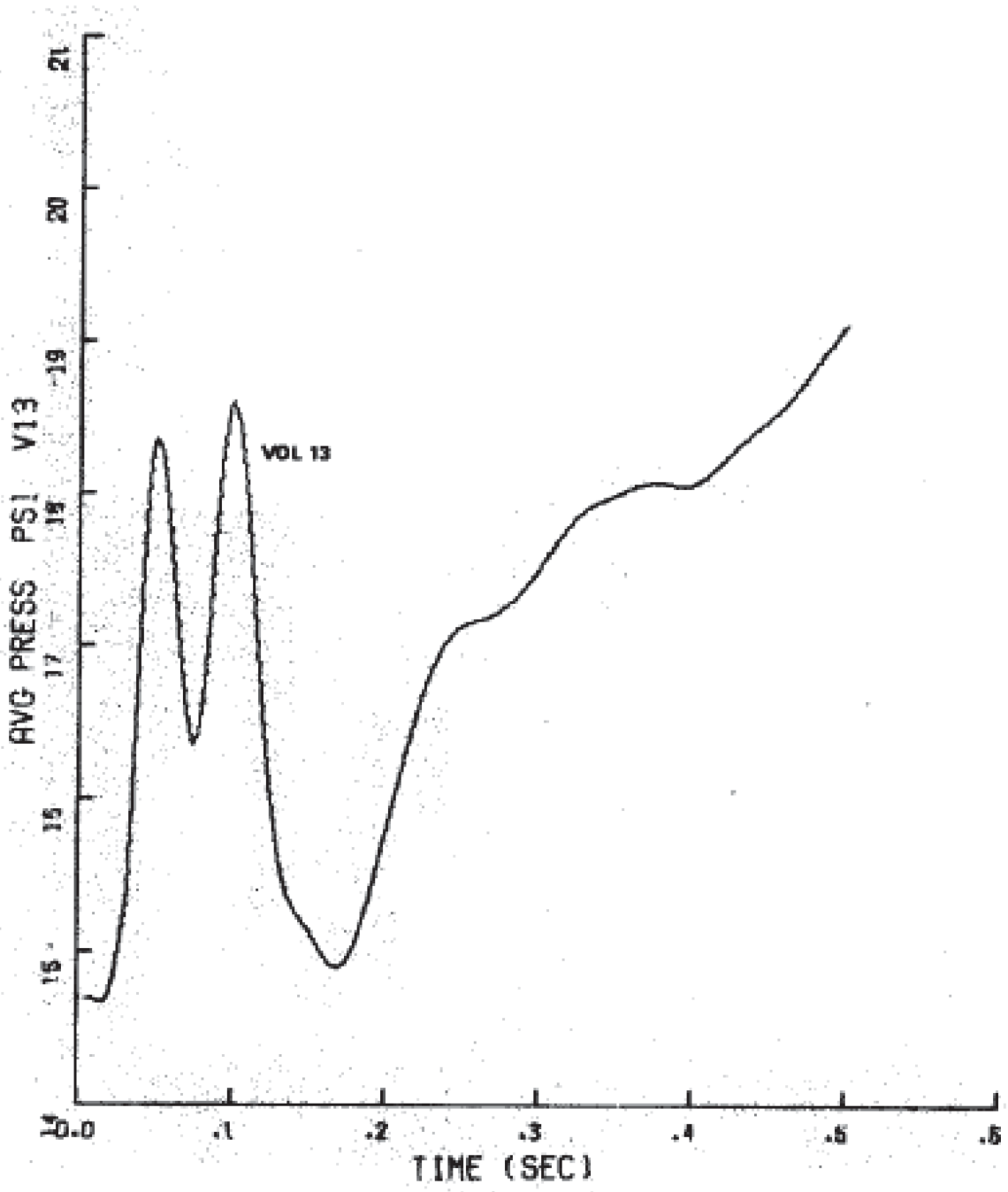
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL)
FIGURE 6.2-28f



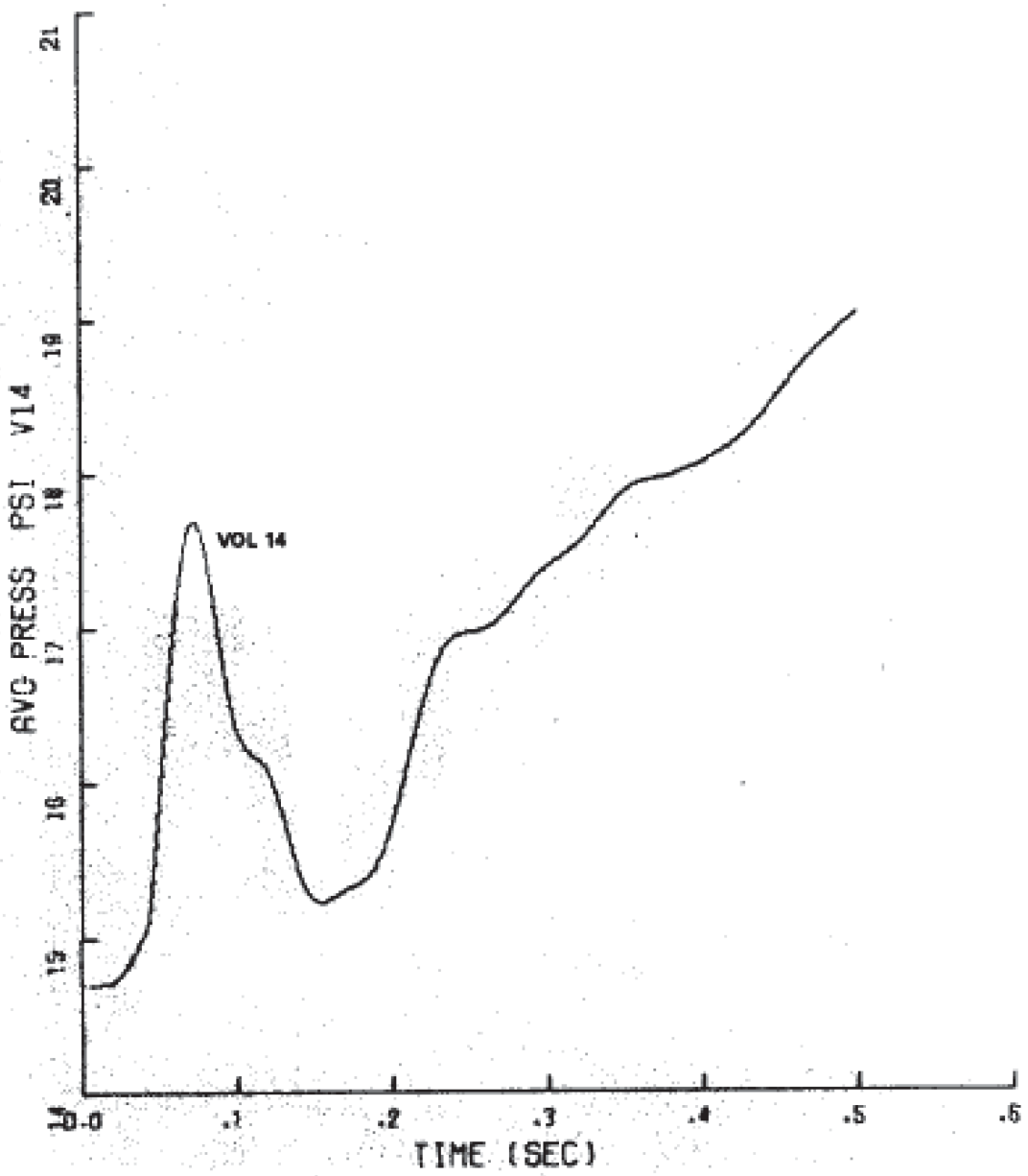
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL)
FIGURE 6.2-28g



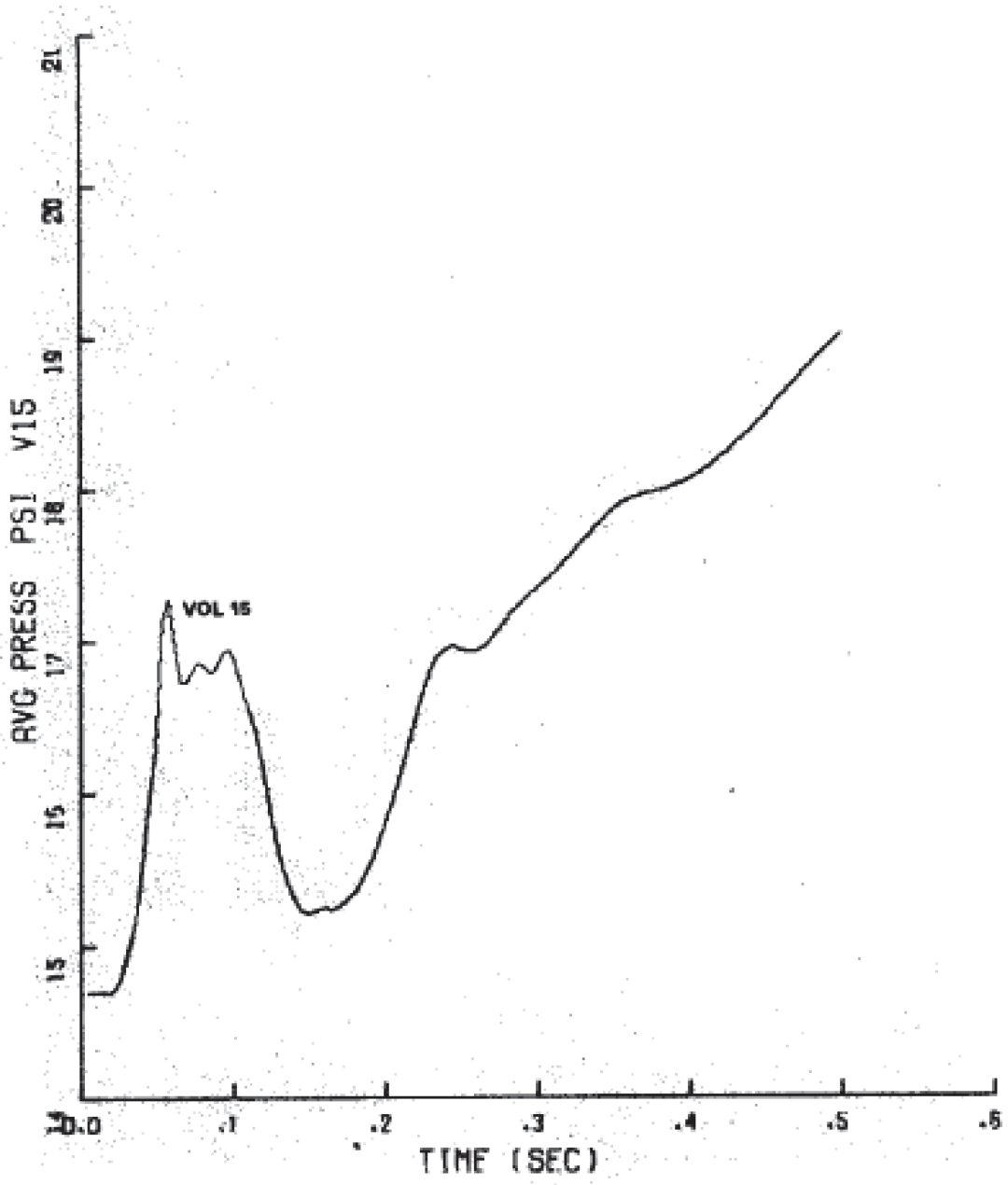
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL)
FIGURE 6.2-28h



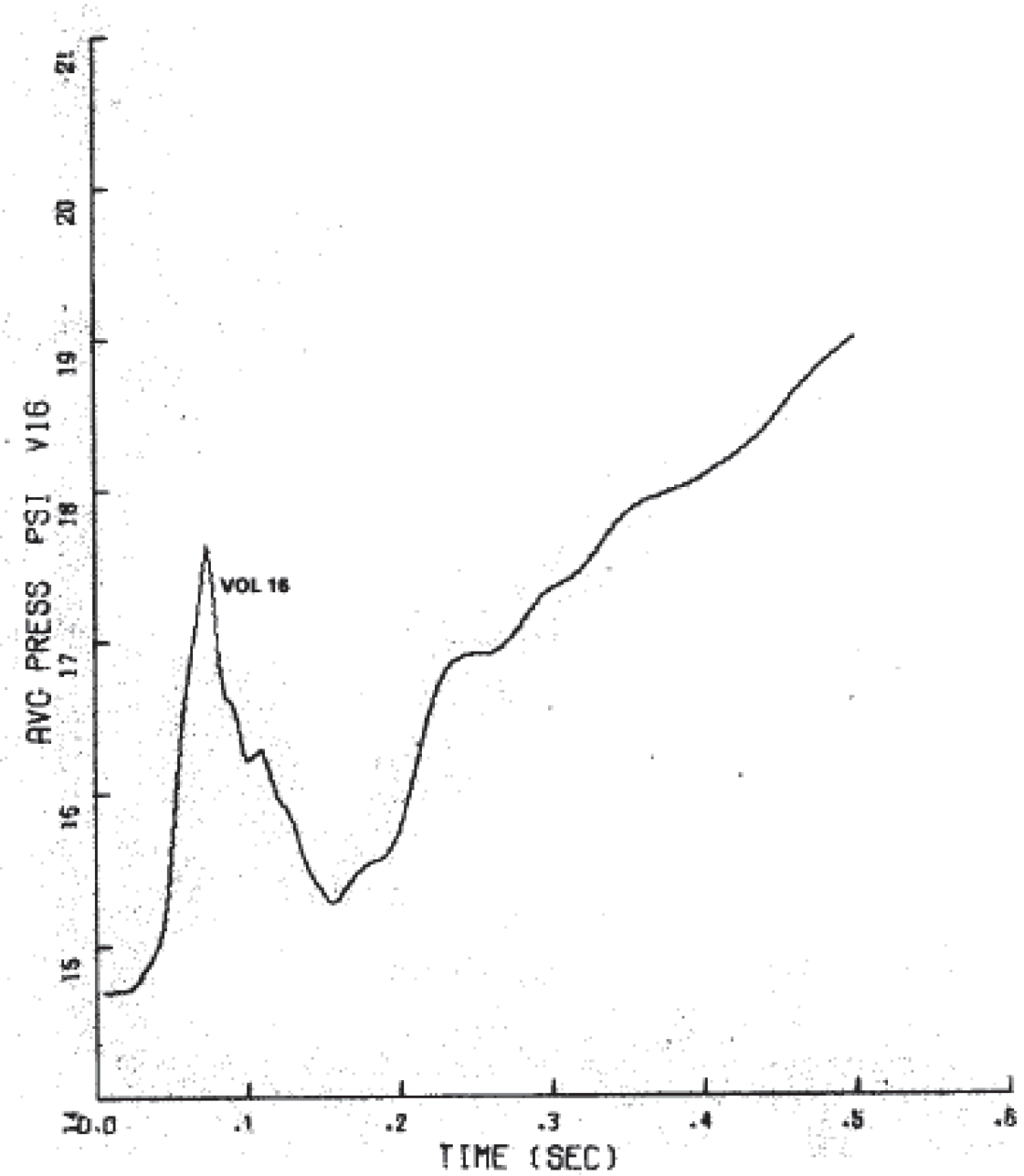
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL)
FIGURE 6.2-28i



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL)
FIGURE 6.2-28j

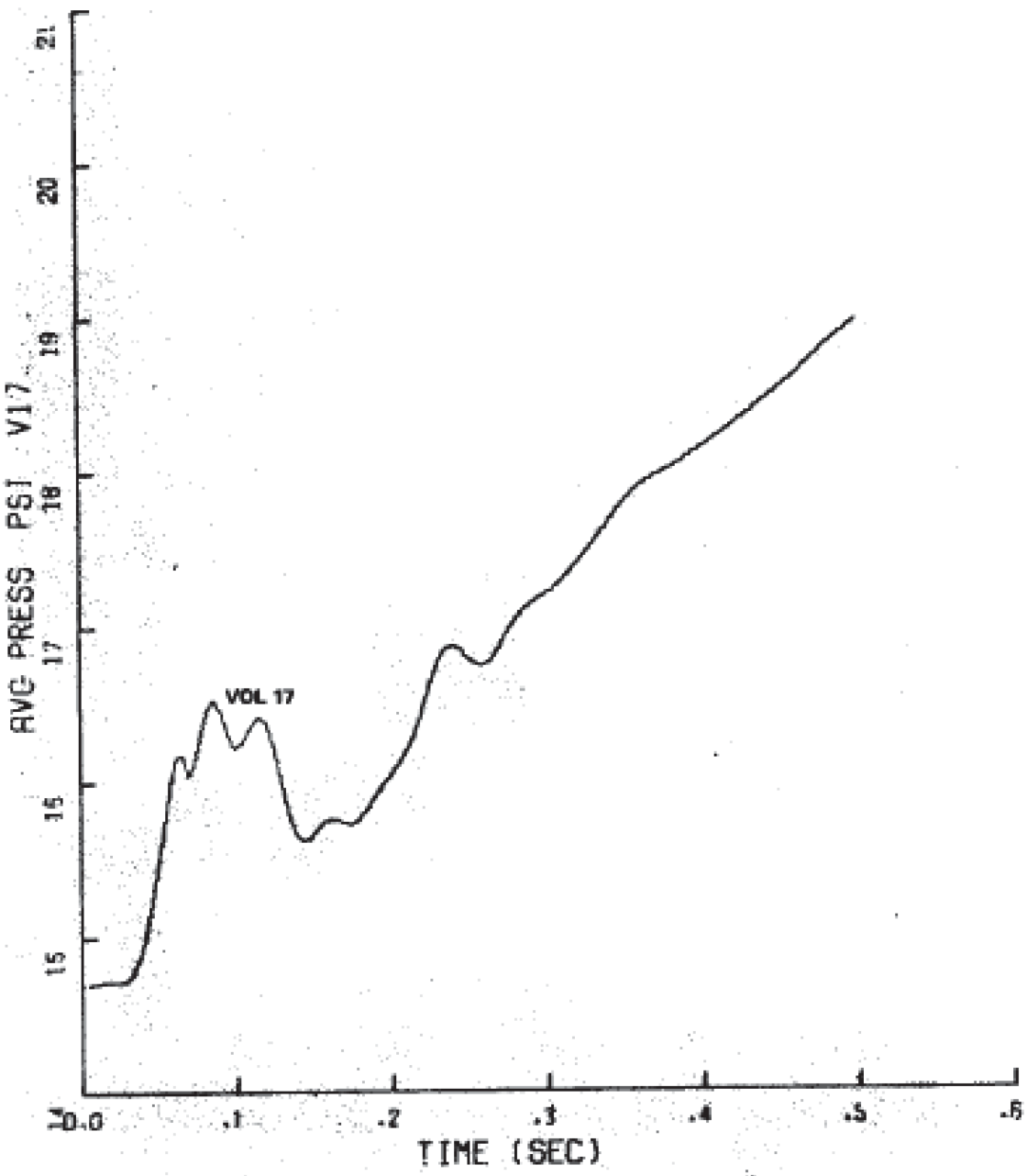


FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SECONDARY SHIELD WALL AREA PRESSURE – SUCTION LEG GUILLOTINE BREAK AT S.G. NOZZLE (HISTORICAL)

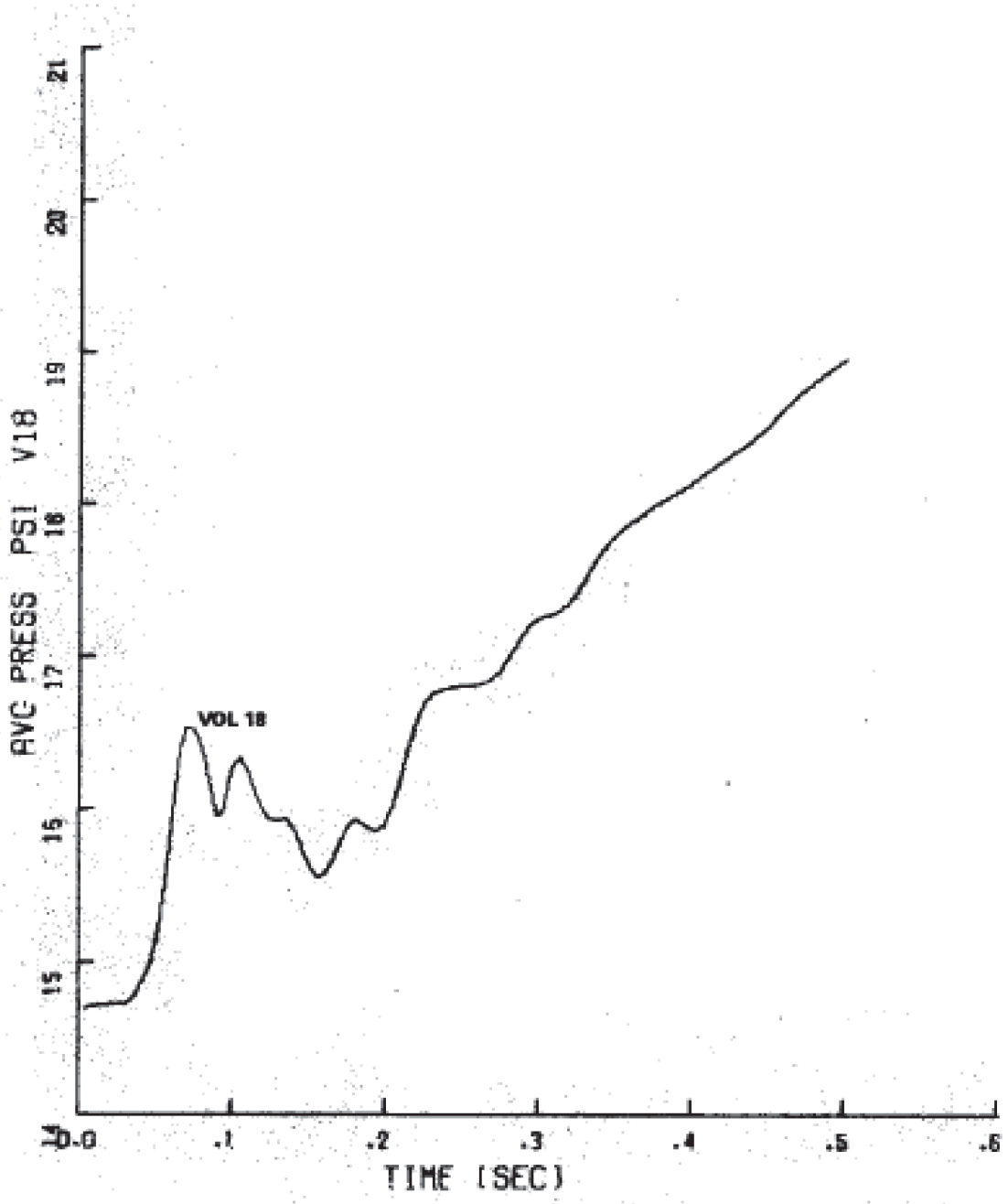
FIGURE 6.2-28k

Amendment No. 21 (11/12)



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

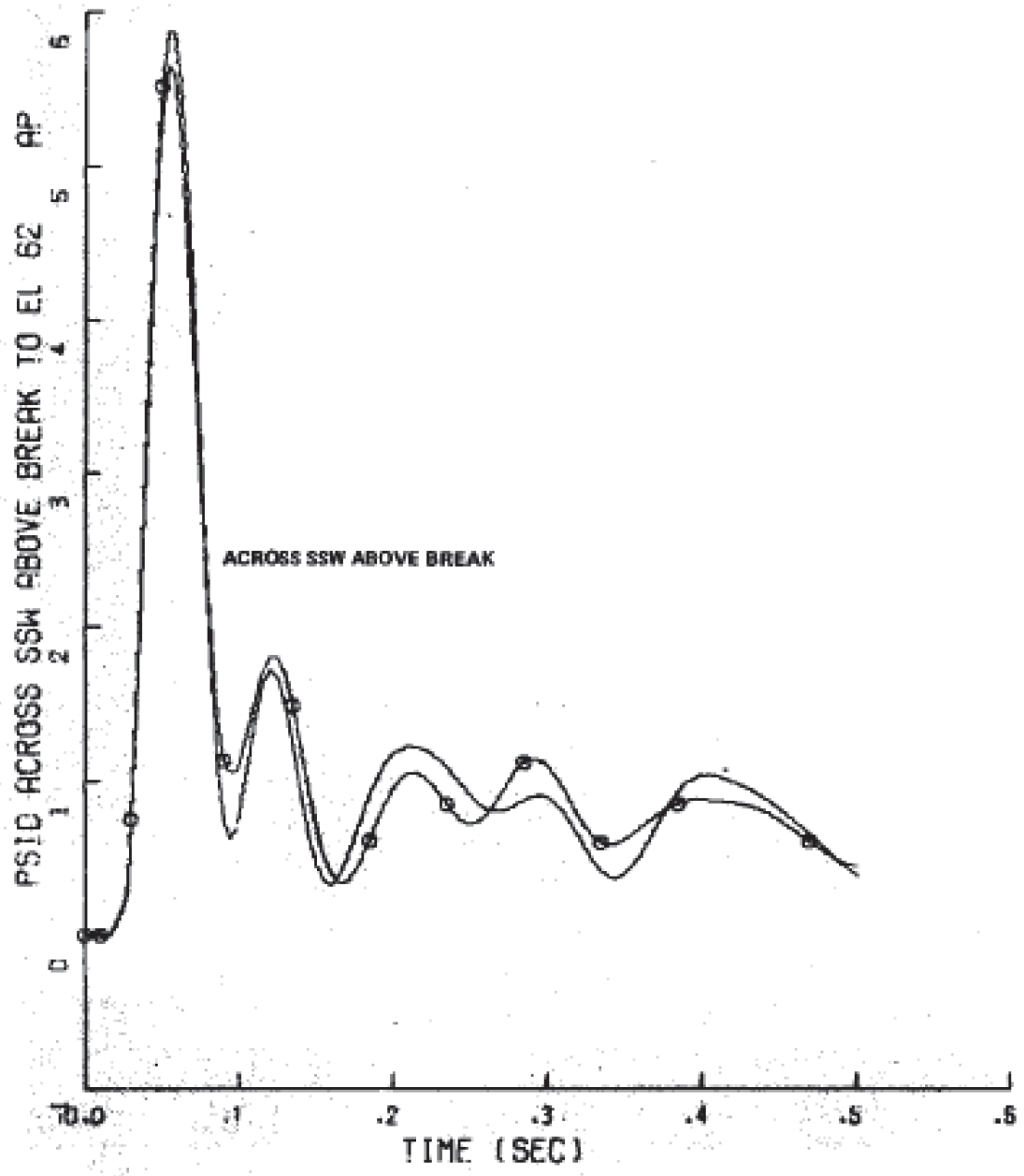
SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL)
FIGURE 6.2-28I



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

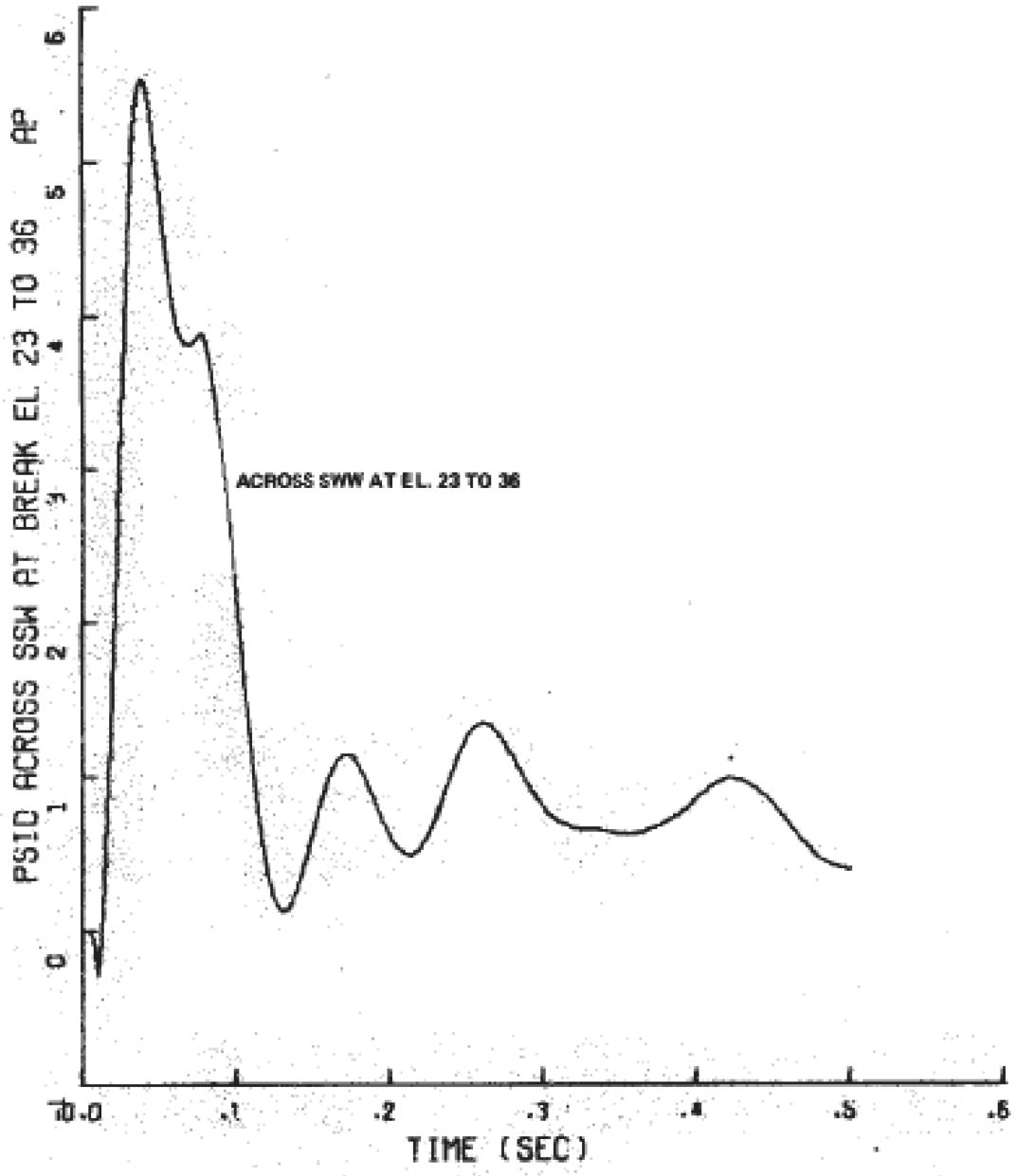
SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL)
FIGURE 6.2-28m

Amendment No. 21 (11/12)



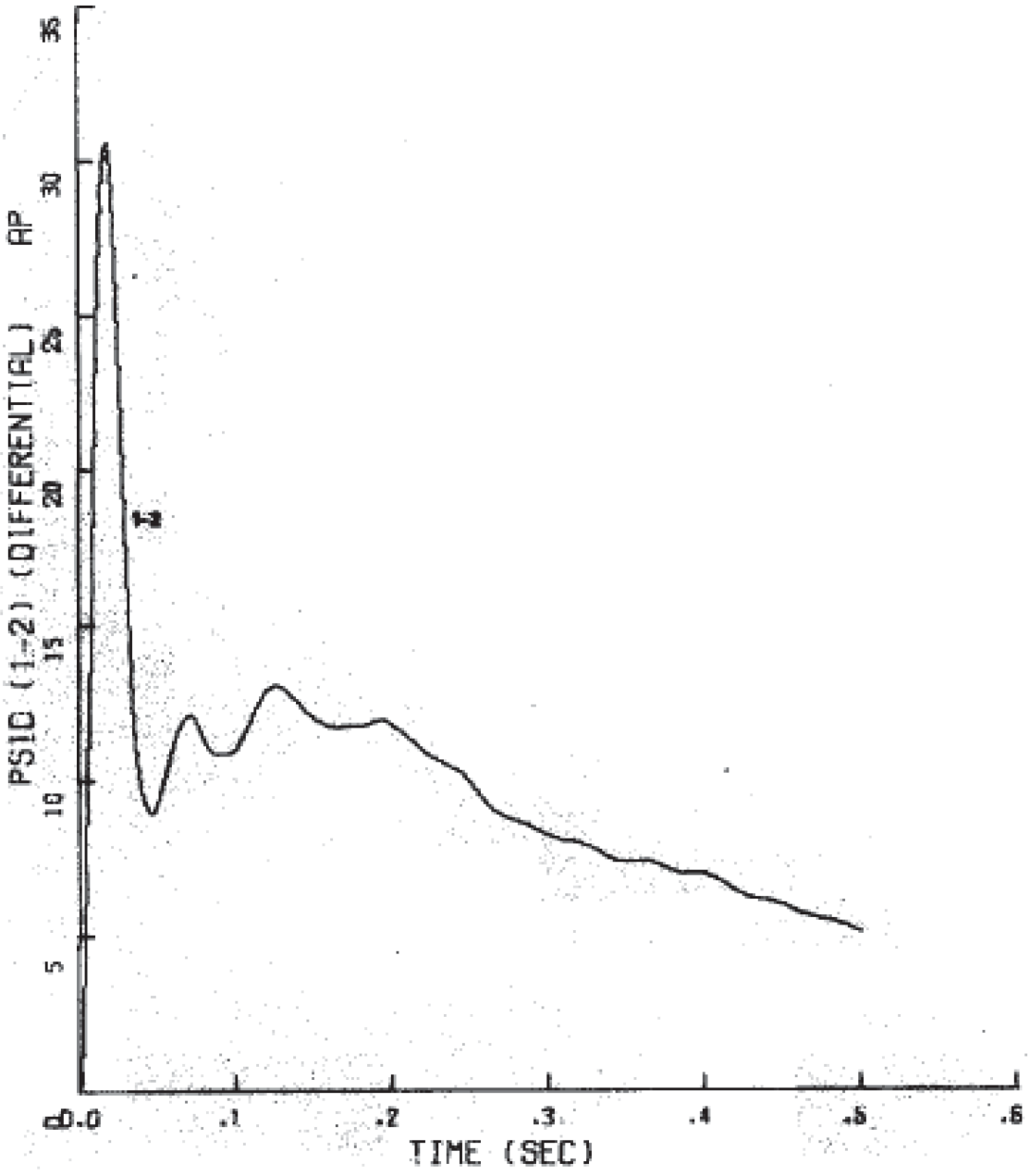
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL
FIGURE 6.2-28n



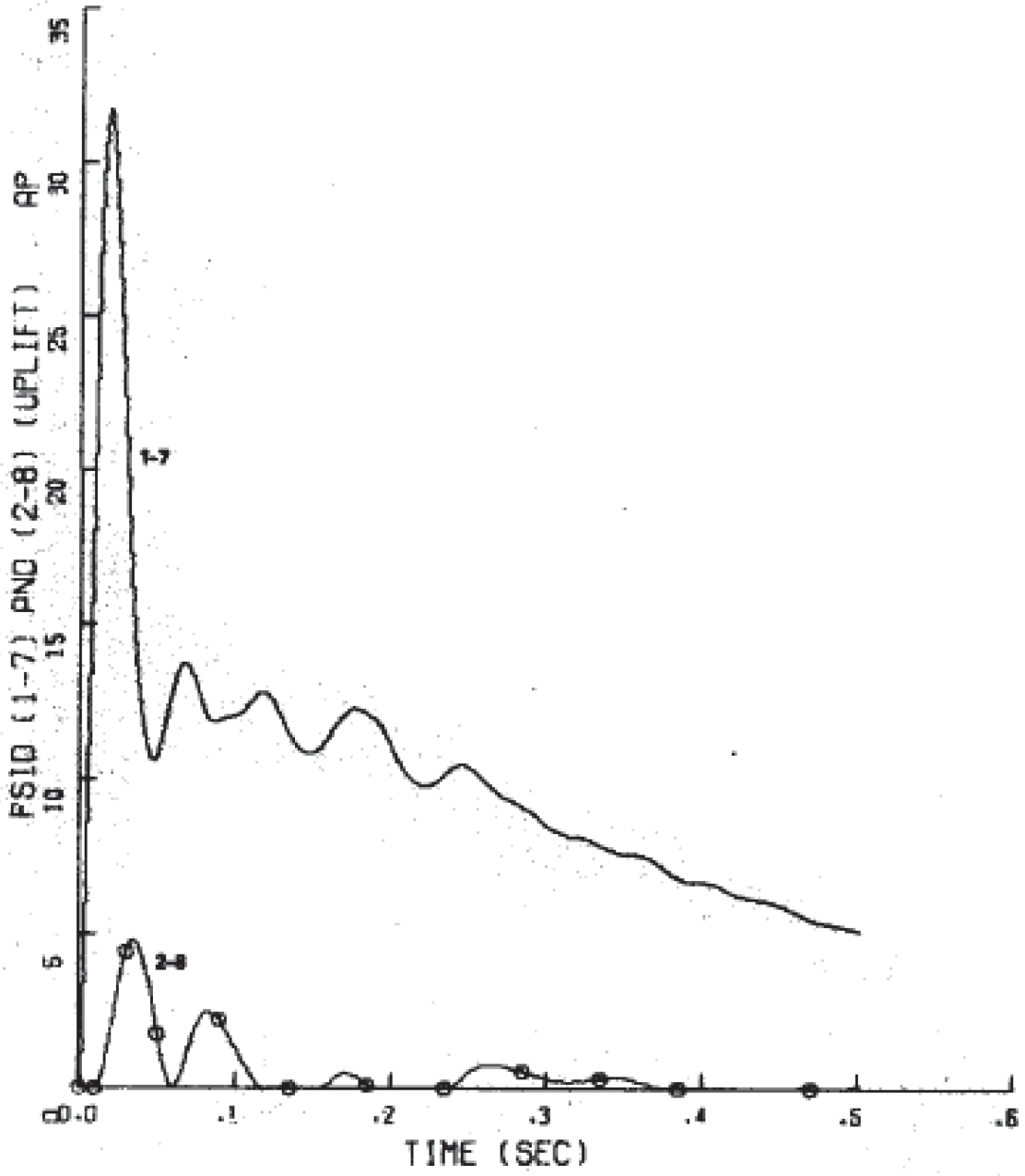
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL)
FIGURE 6.2-28o



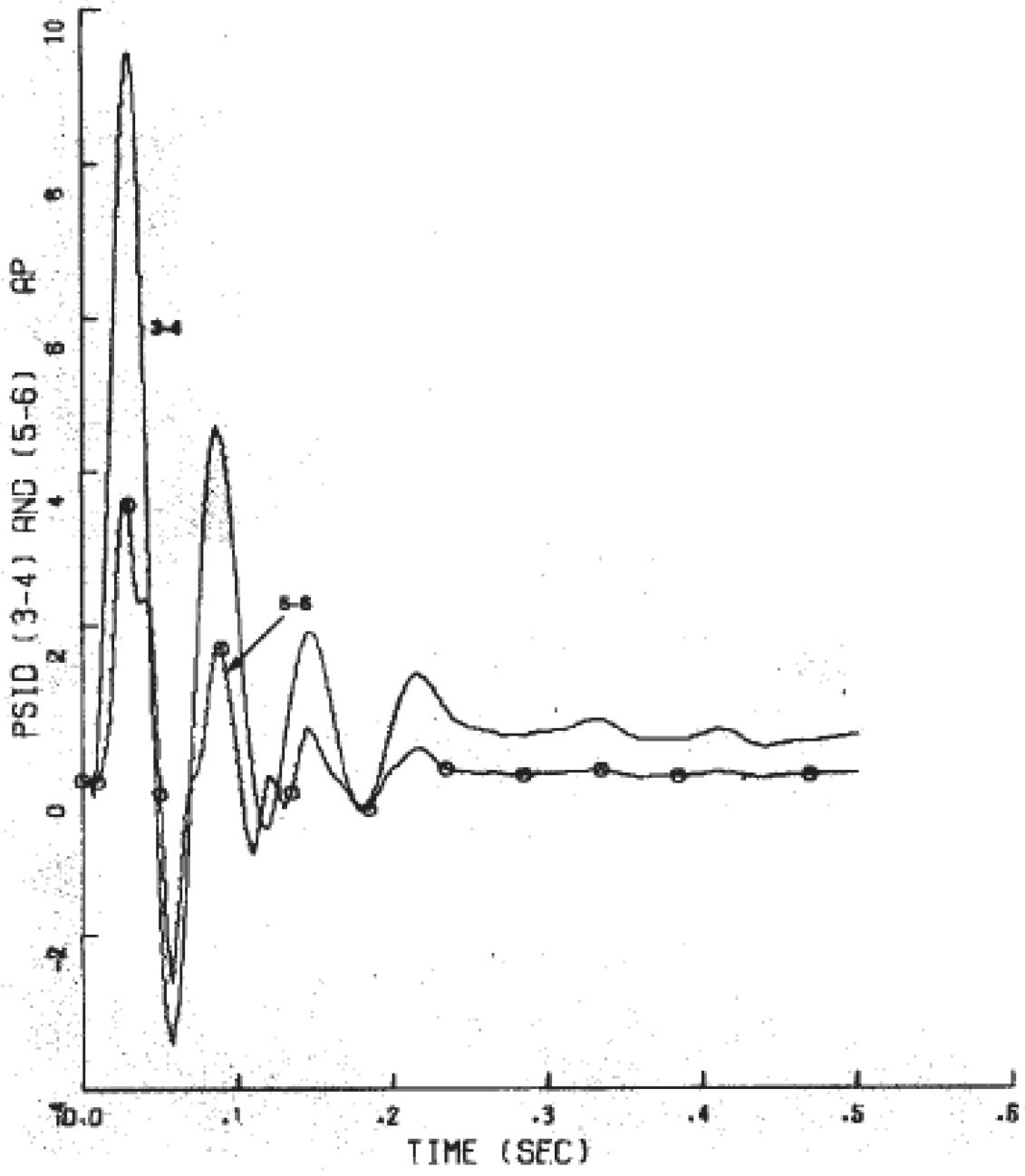
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL)
FIGURE 6.2-28p



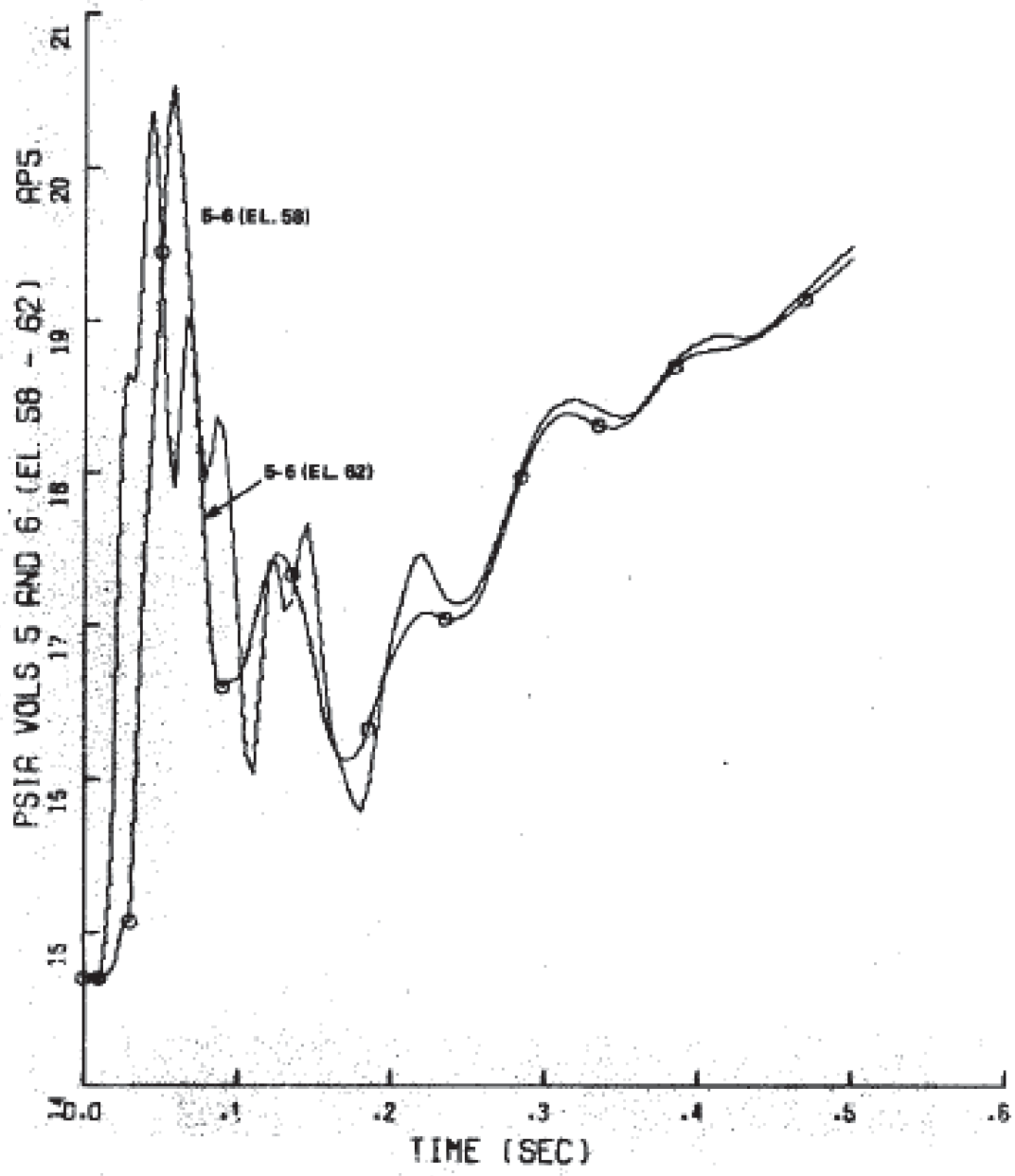
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL)
FIGURE 6.2-28q



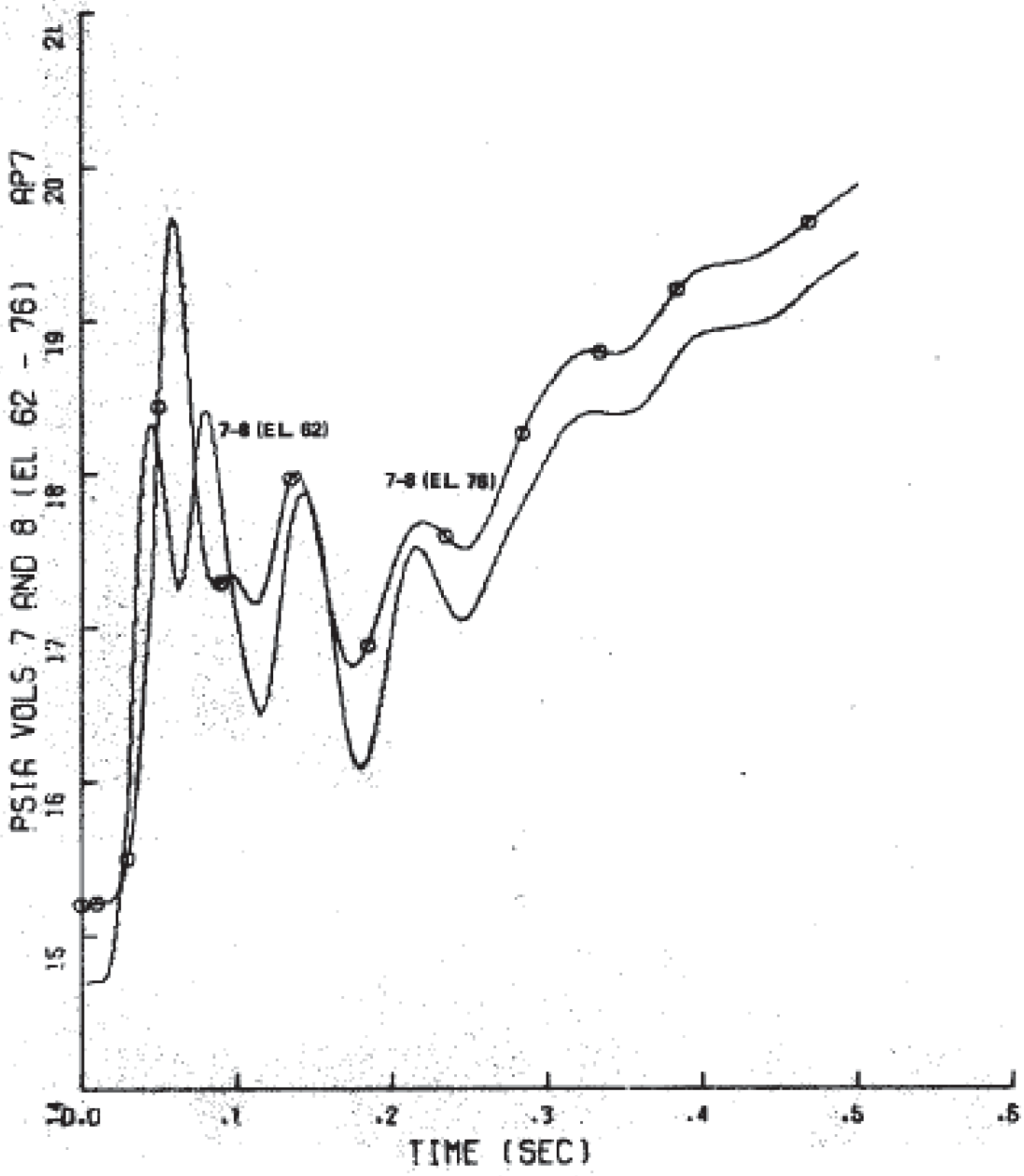
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL)
FIGURE 6.2-28r



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

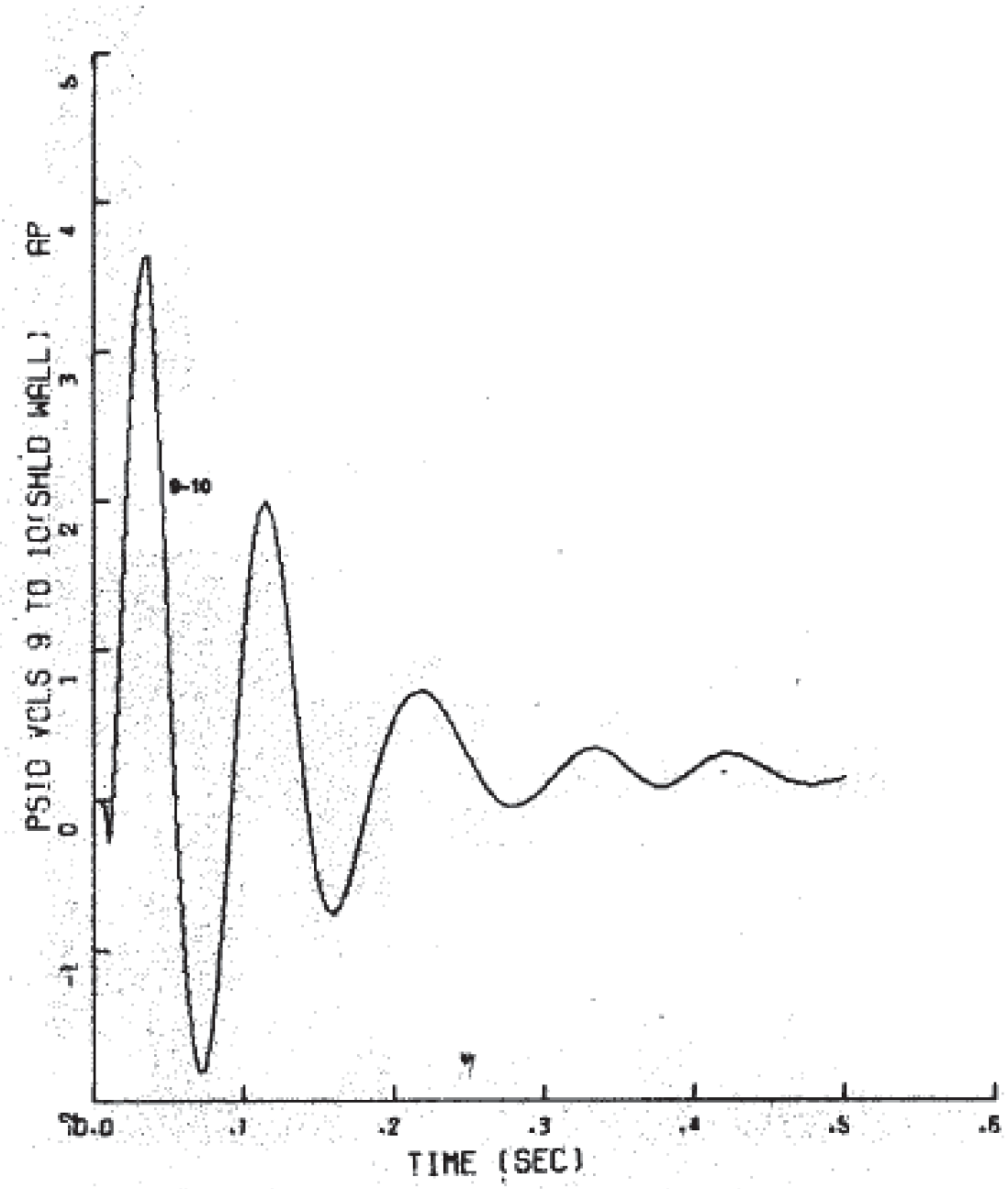
SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL)
FIGURE 6.2-28s



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL)
FIGURE 6.2-28t

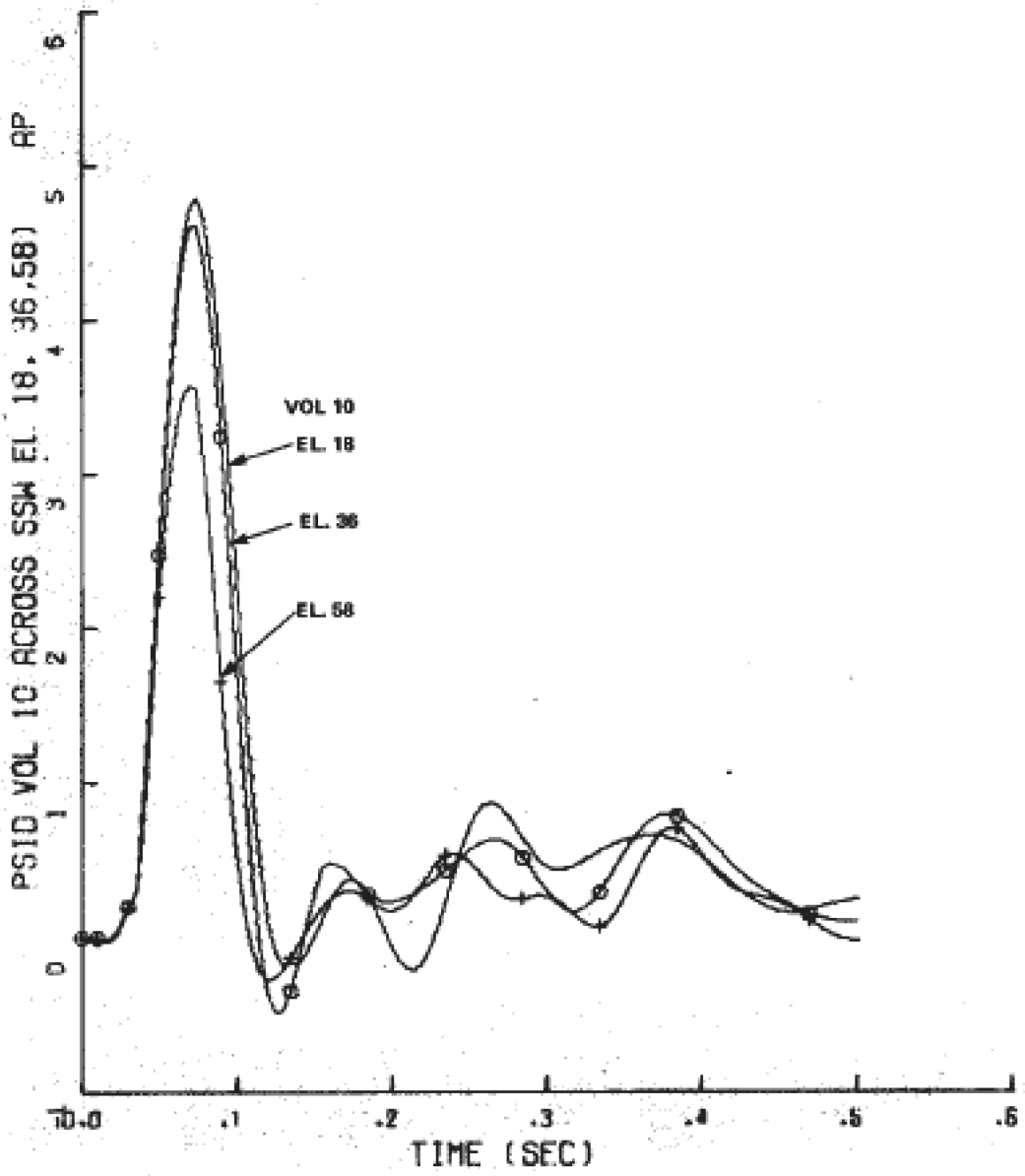
Amendment No. 21 (11/12)



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL)
FIGURE 6.2-28u

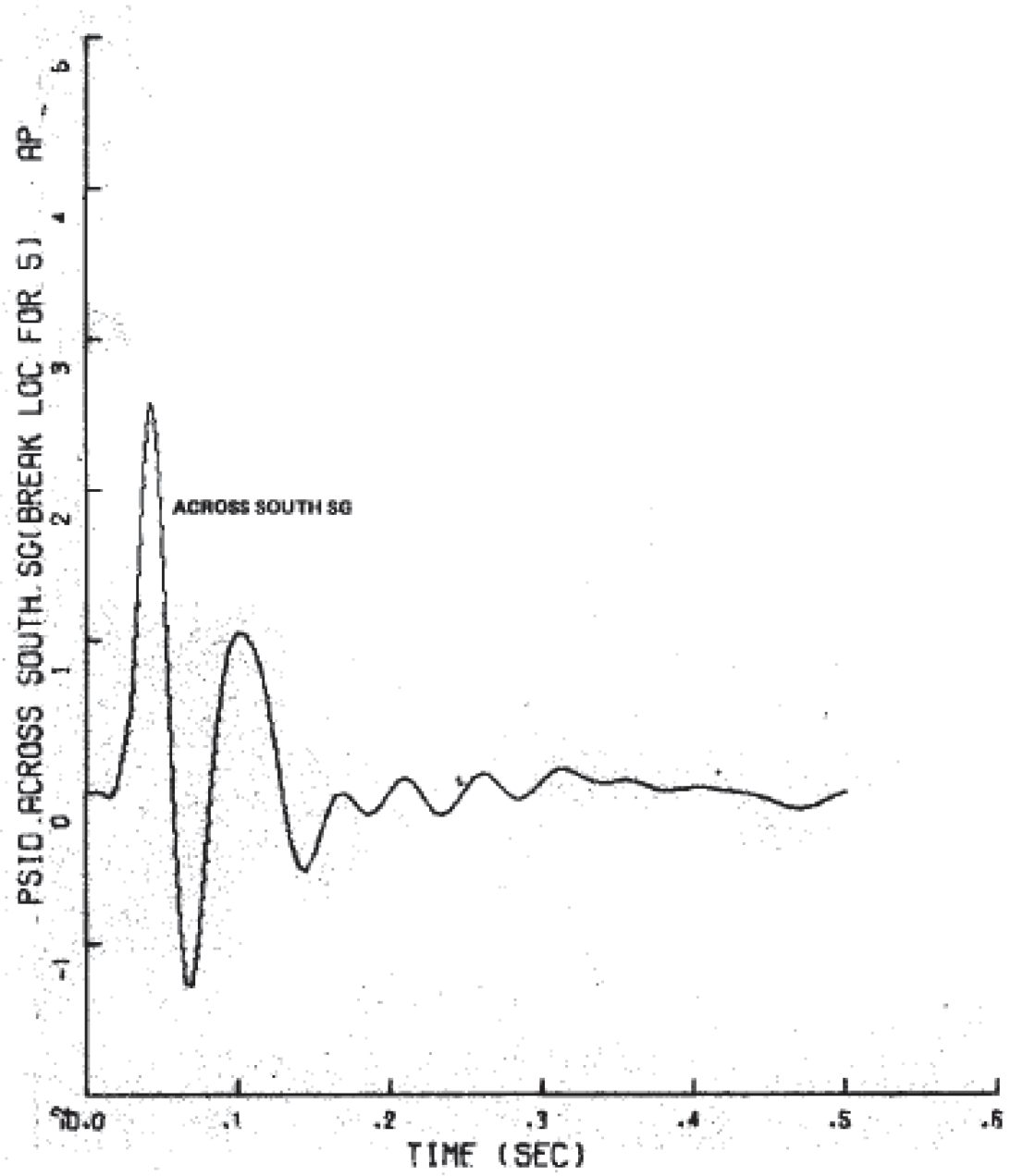
Amendment No. 21 (11/12)



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

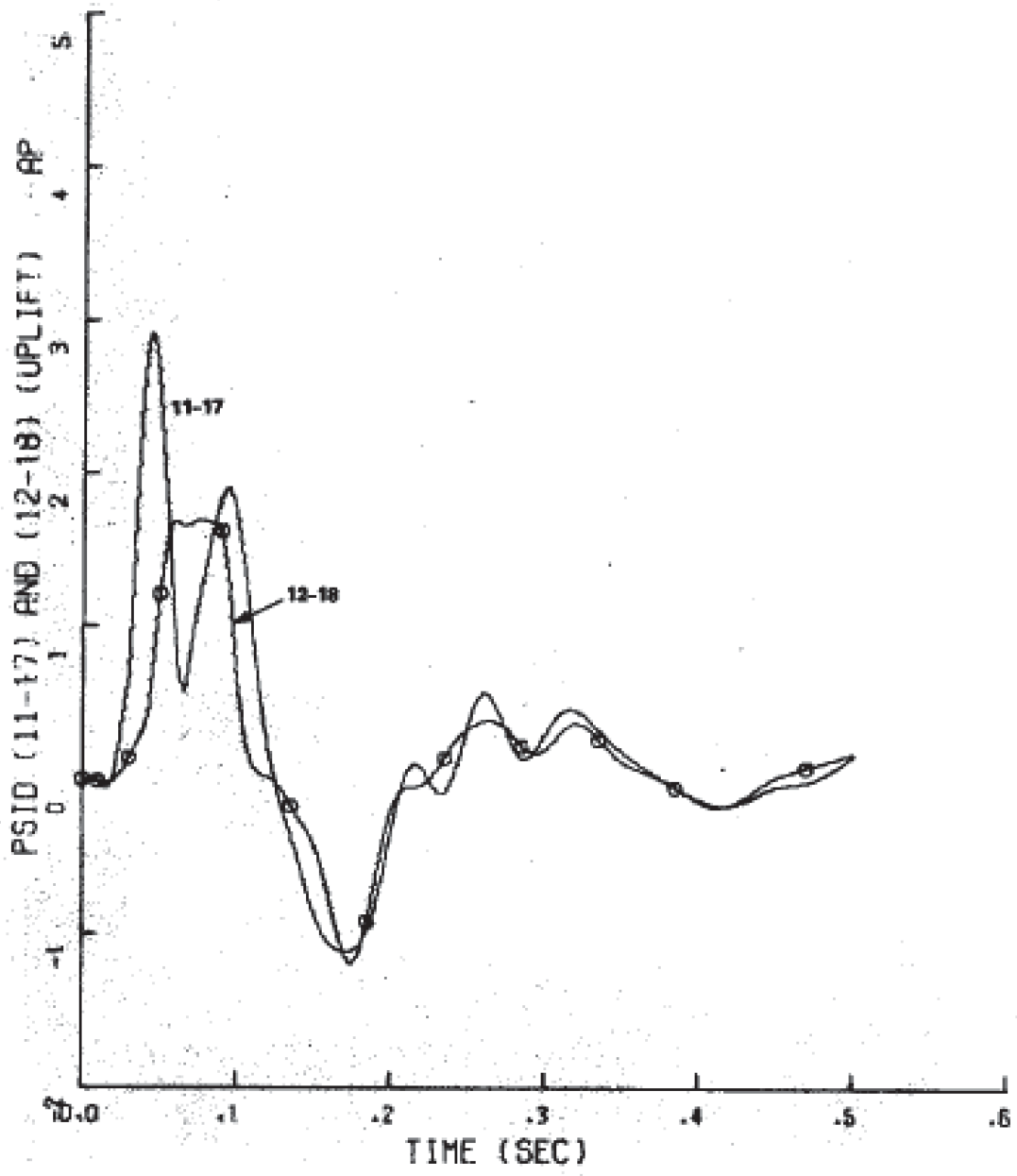
SECONDARY SHIELD WALL AREA
PRESSURE-SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL)
FIGURE 6.2 –28v

Amendment No. 21 (11/12)



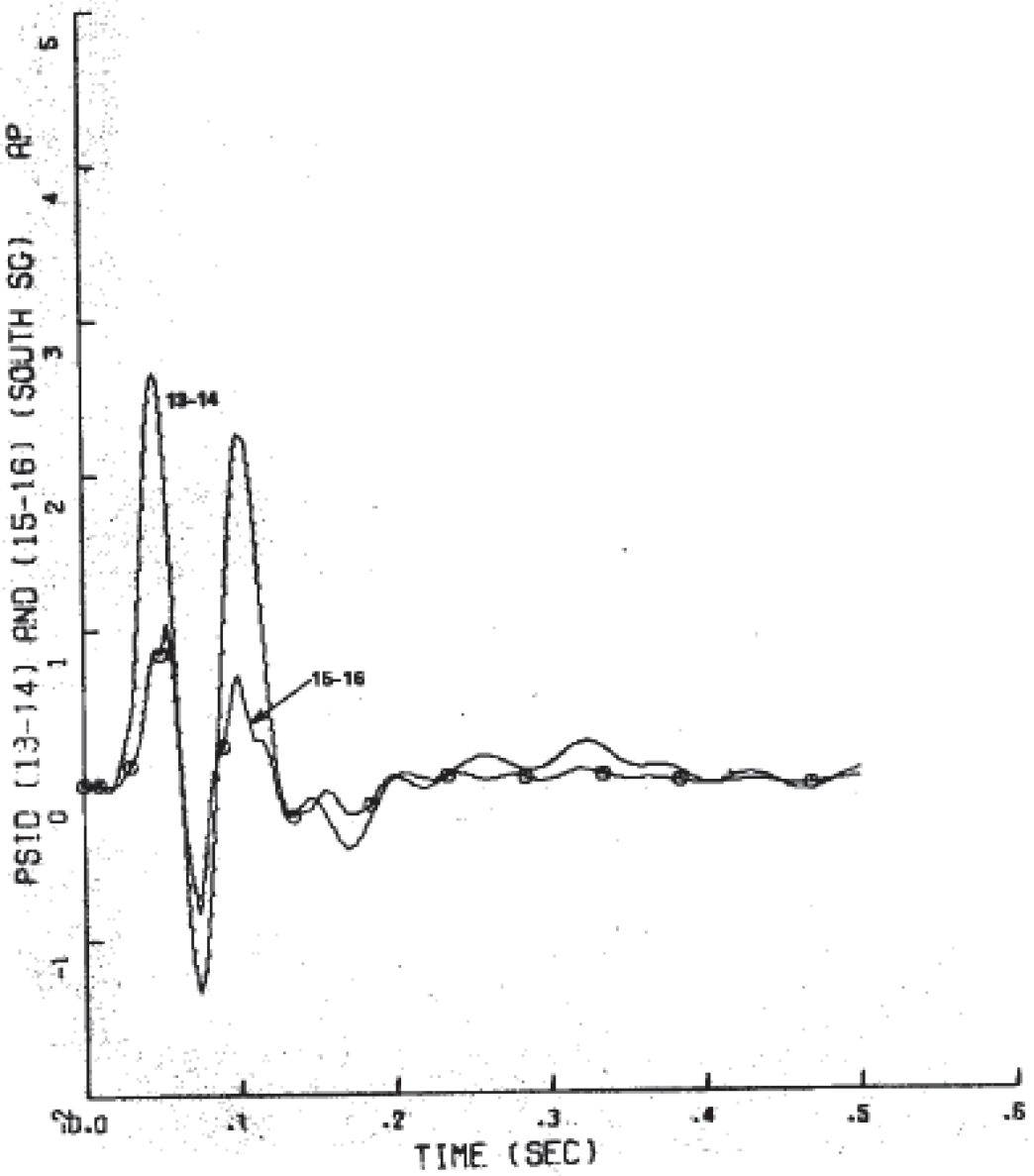
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL)
FIGURE 6.2-28w



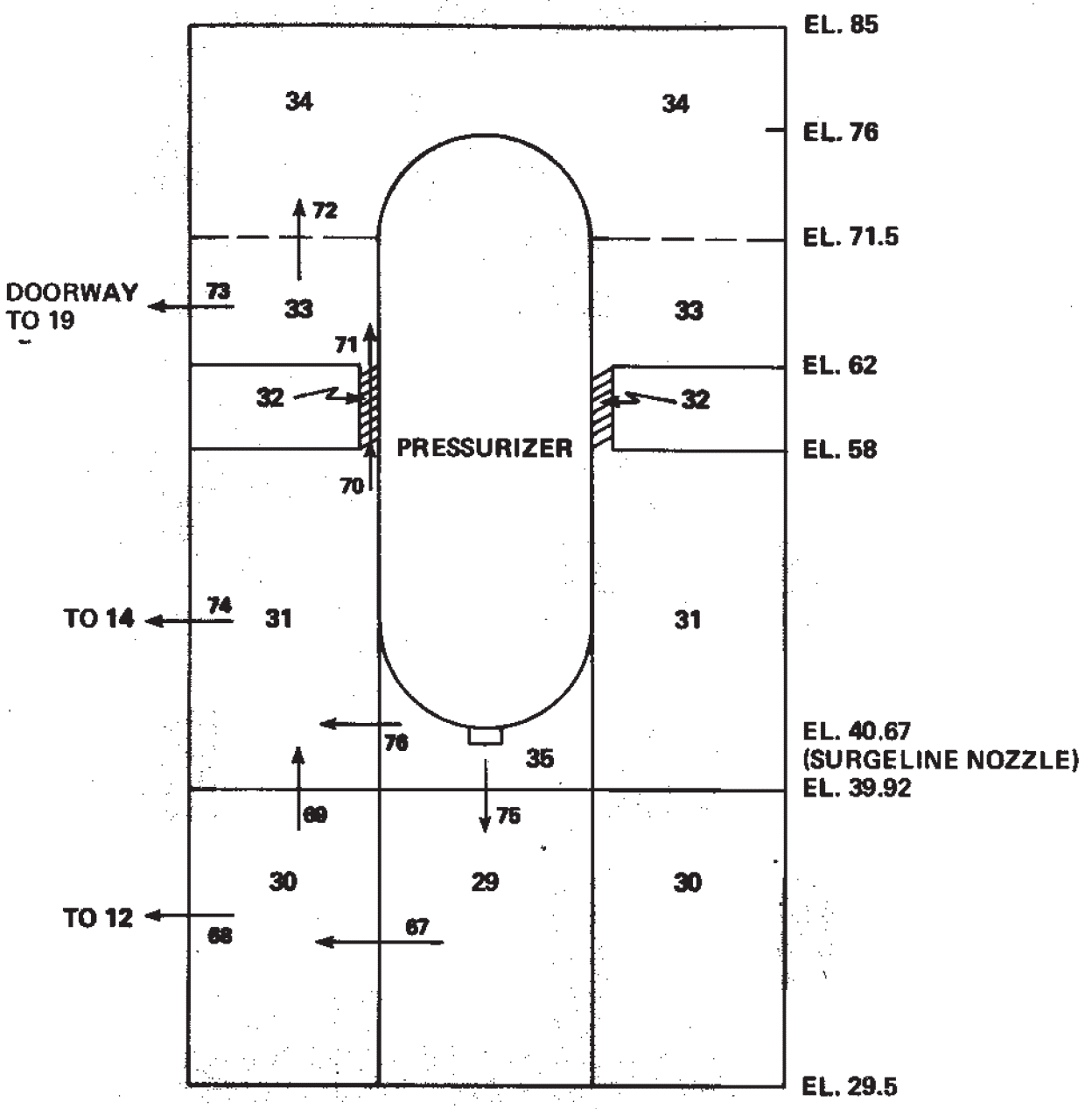
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HISTORICAL)
FIGURE 6.2-28x



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SECONDARY SHIELD WALL AREA
PRESSURE – SUCTION LEG GUILLOTINE
BREAK AT S.G. NOZZLE
(HITORICAL)
FIGURE 6.2-28y



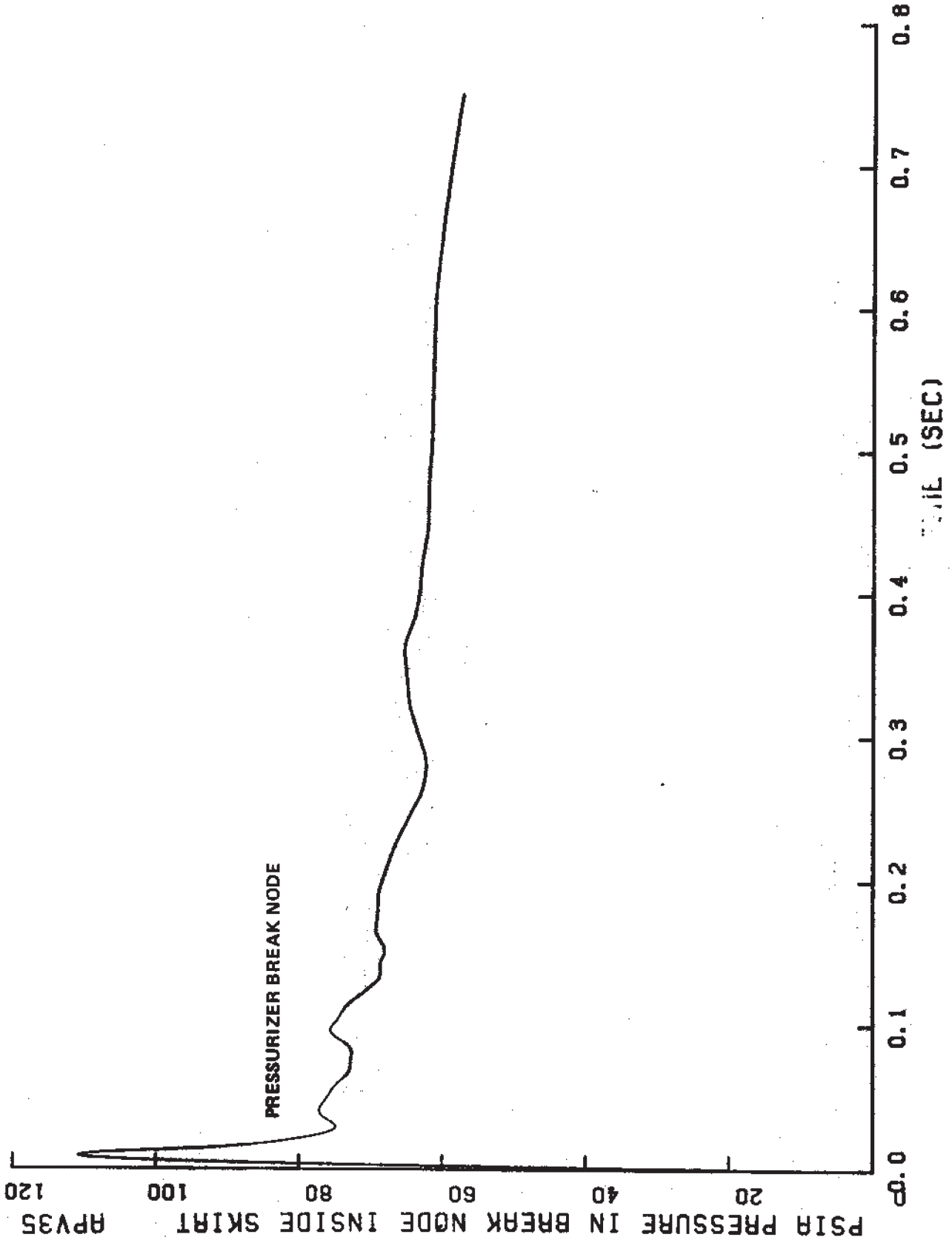
BREAK LOCATIONS

35 (SURGELINE)
34 (SPRAY AND RELIEF LINES)

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

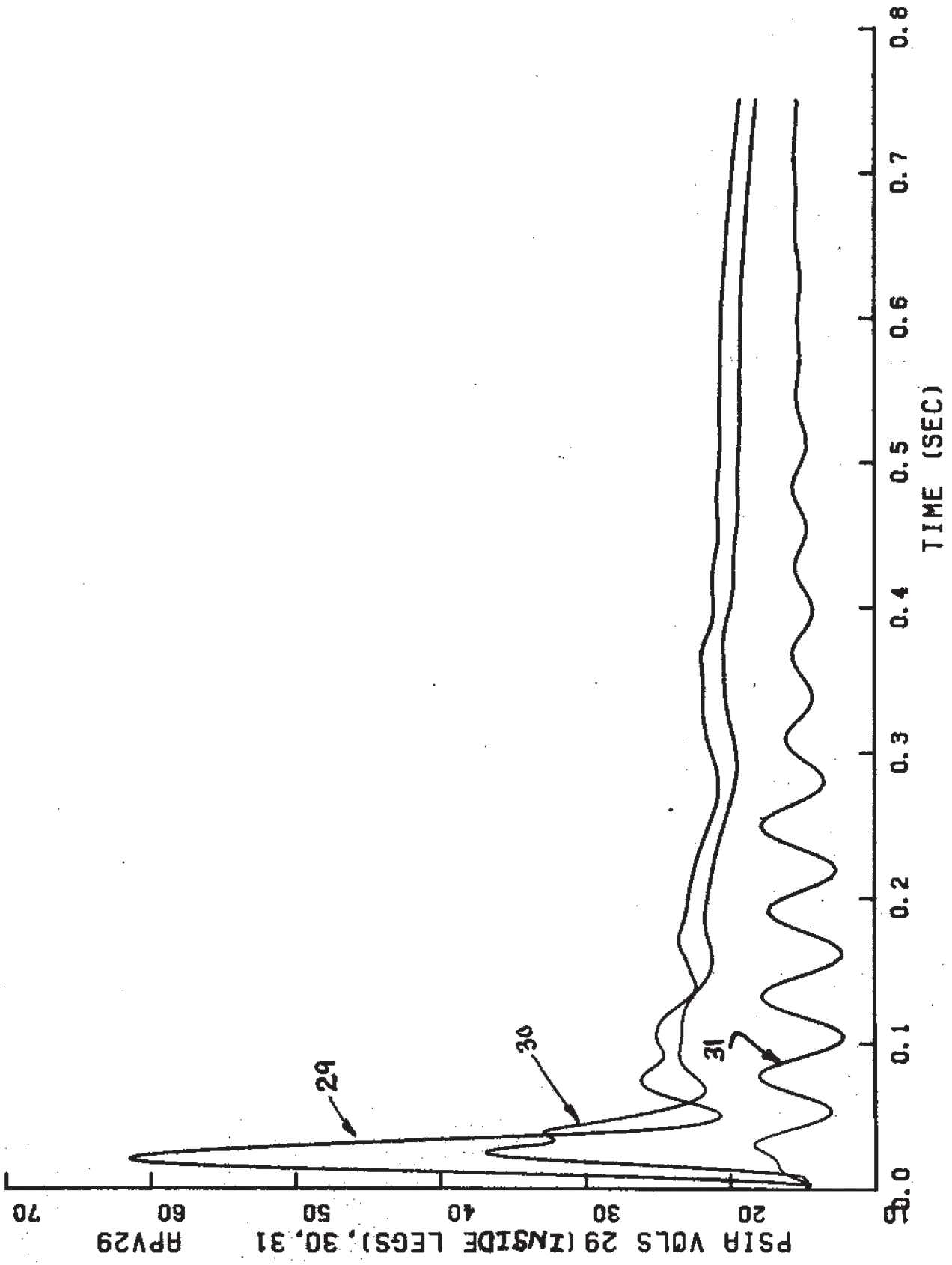
PRESSURIZER AREA - MODEL
SCHEMATIC (SECTIONAL VIEW)

FIGURE 6.2-29



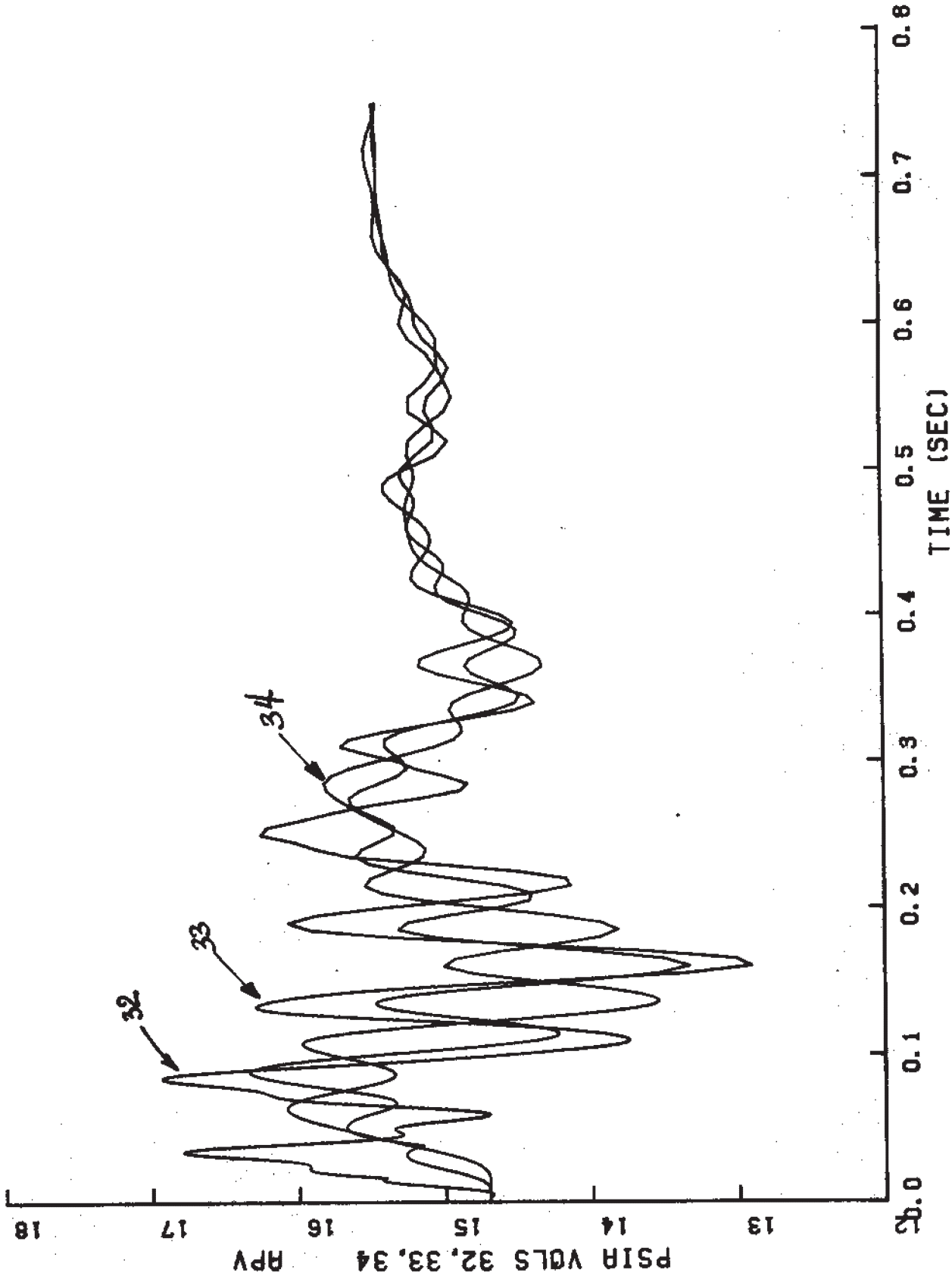
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

PRESSURIZER AREA PRESSURE
SURGE LINE GUILLOTINE BREAK AT
PRESSURIZER NOZZLE
FIGURE 6.2–30a



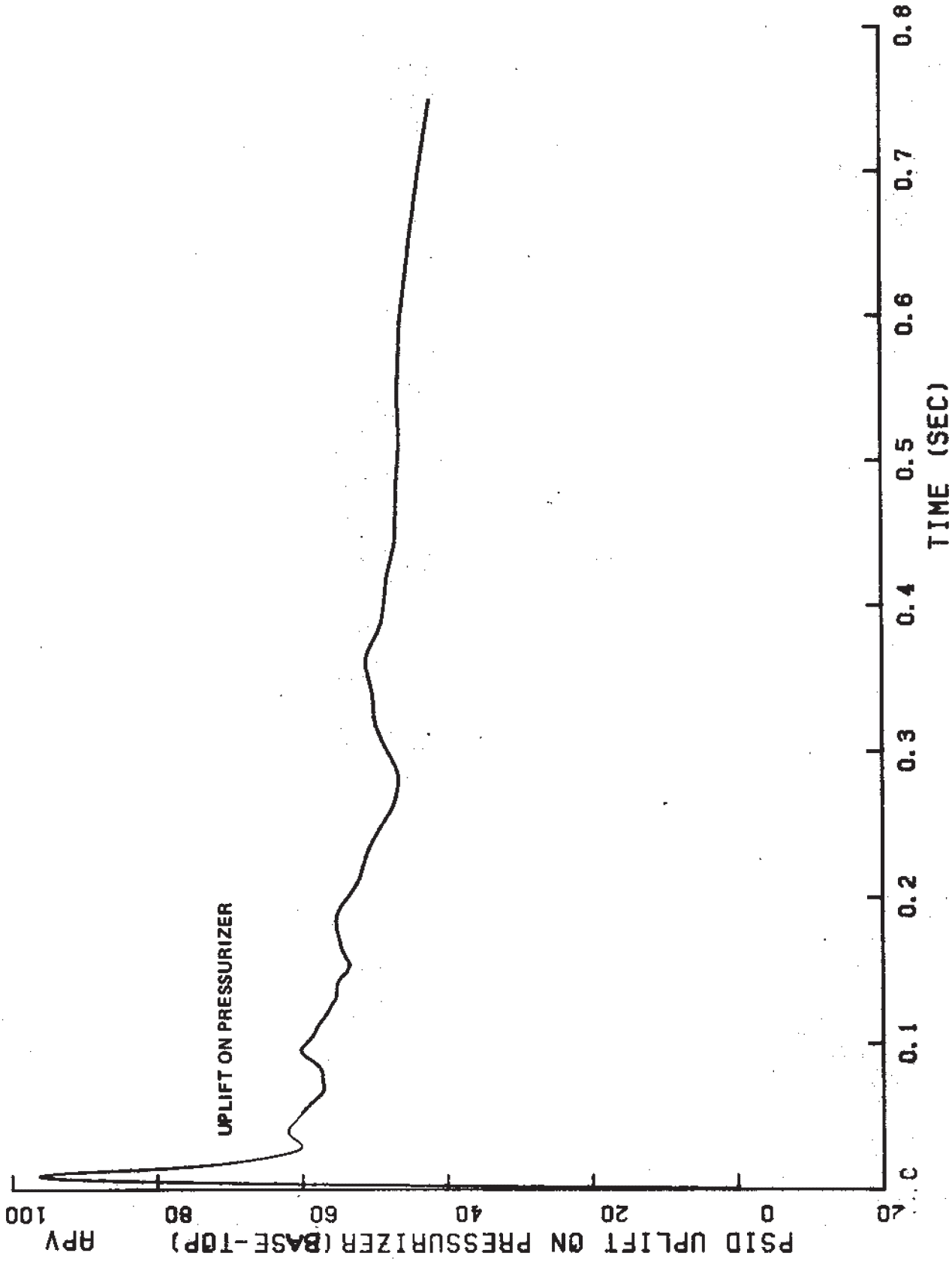
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

PRESSURIZER AREA PRESSURE
SURGE LINE GUILLOTINE BREAK AT
PRESSURIZER NOZZLE
FIGURE 6.2–30b



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

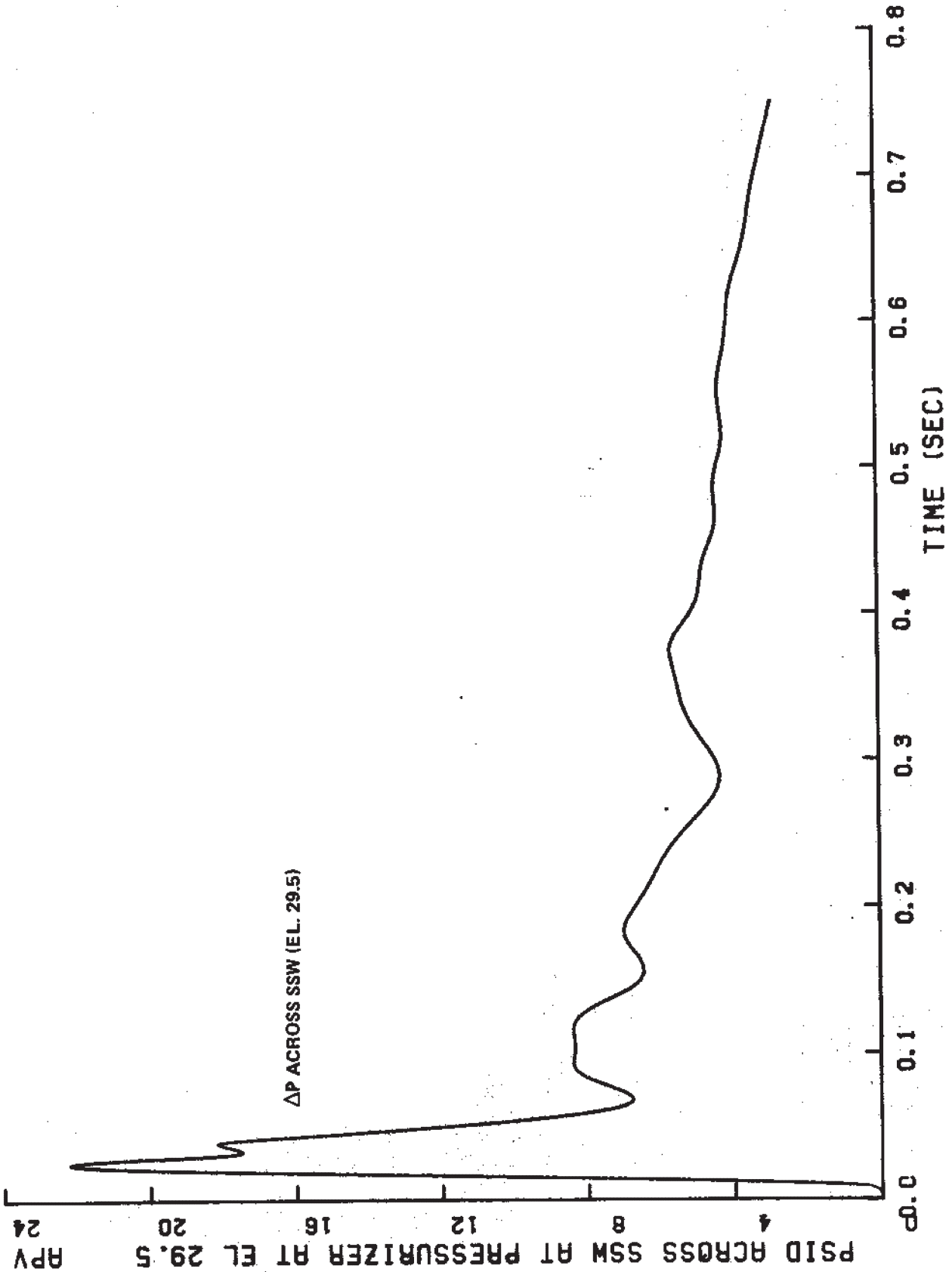
PRESSURIZER AREA PRESSURE
SURGE LINE GUILLOTINE BREAK AT
PRESSURIZER NOZZLE
FIGURE 6.2–30c



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

PRESSURIZER AREA PRESSURE
SURGE LINE GUILLOTINE BREAK AT
PRESSURIZER NOZZLE

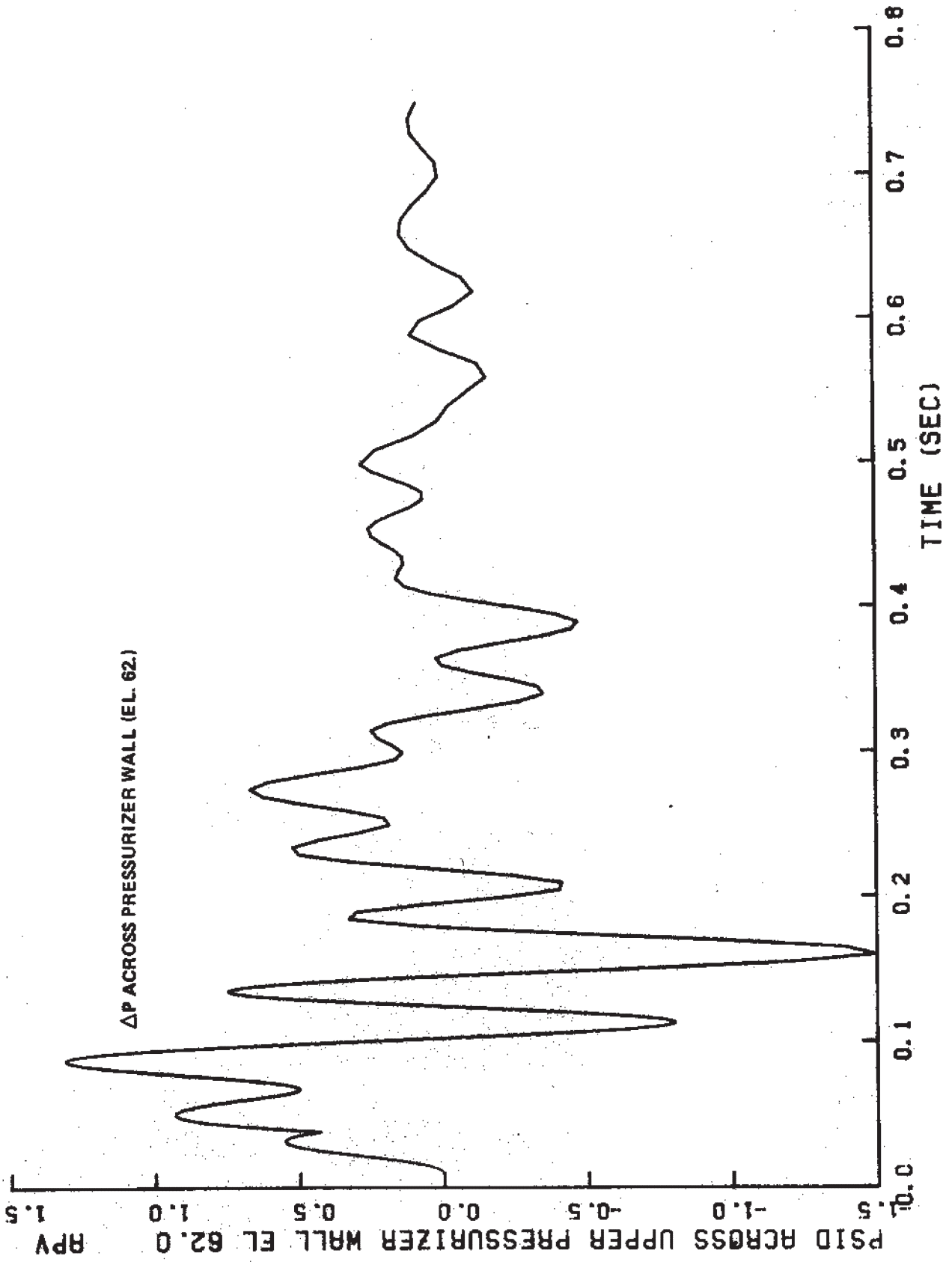
FIGURE 6.2–30d



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

PRESSURIZER AREA PRESSURE
SURGE LINE GUILLOTINE BREAK AT
PRESSURIZER NOZZLE

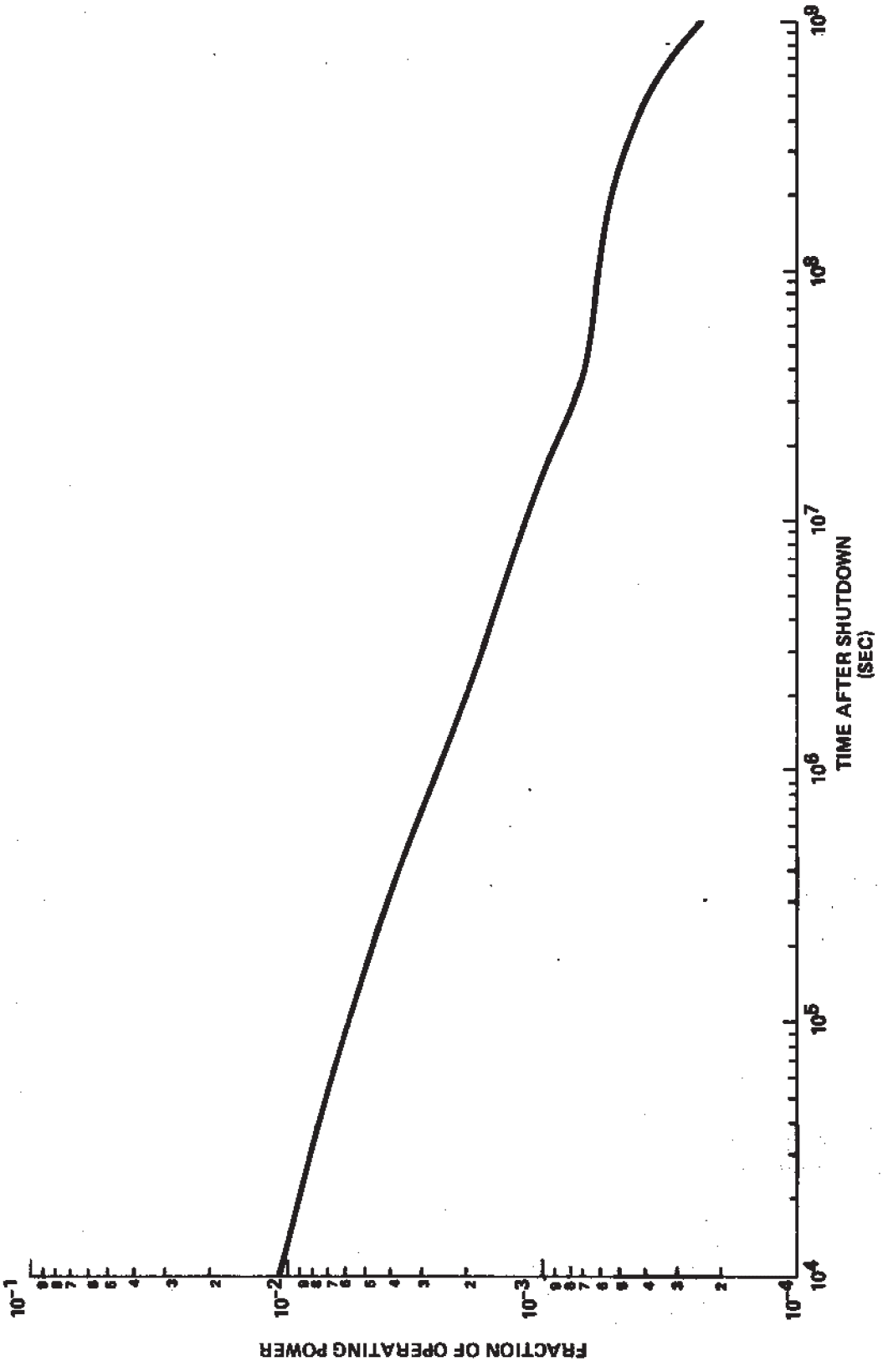
FIGURE 6.2–30e



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

PRESSURIZER AREA PRESSURE
SURGE LINE GUILLOTINE BREAK AT
PRESSURIZER NOZZLE

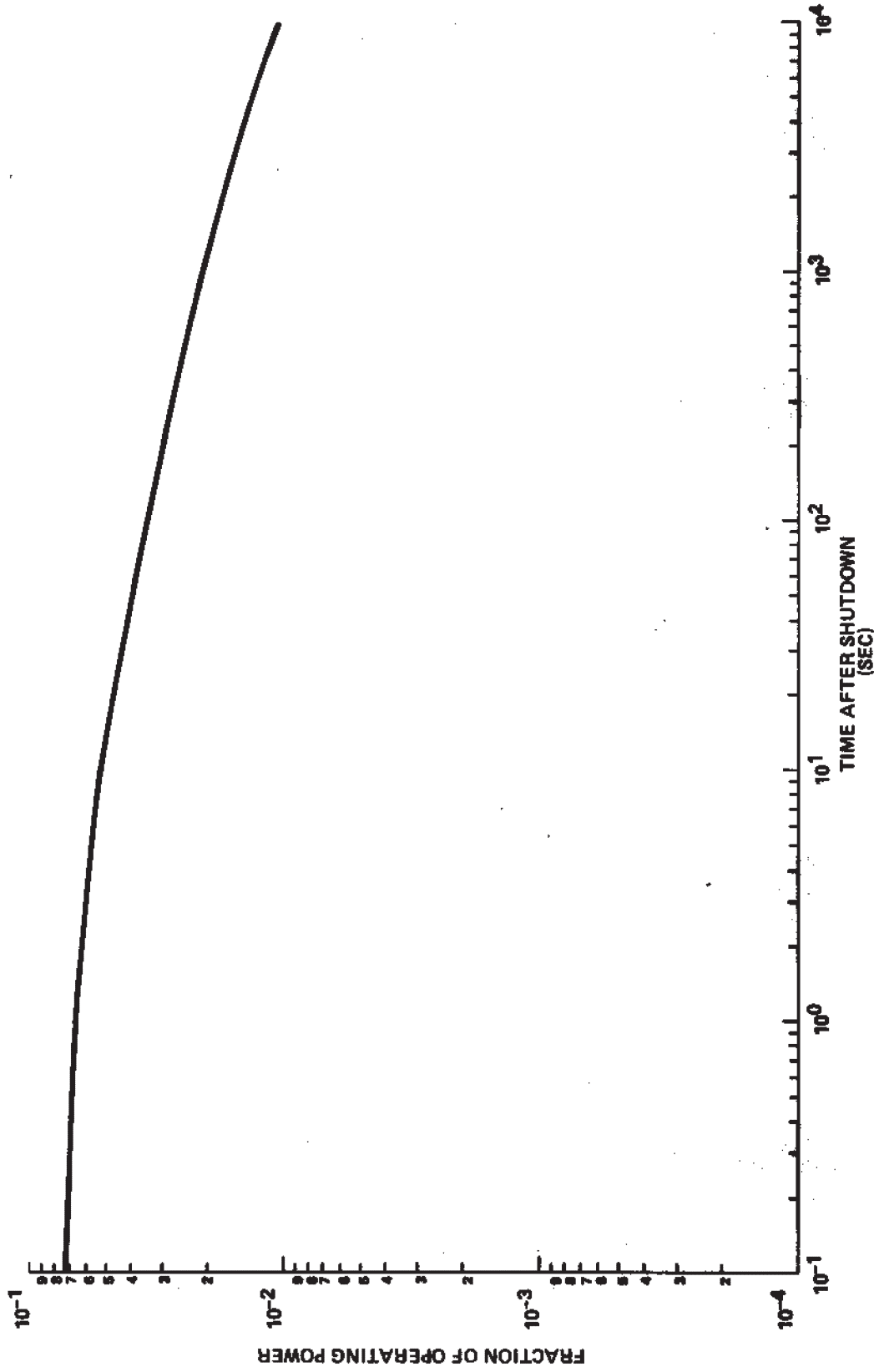
FIGURE 6.2–30f



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

STANDARD FISSION PRODUCT DECAY HEAT CURVE (SH.1)

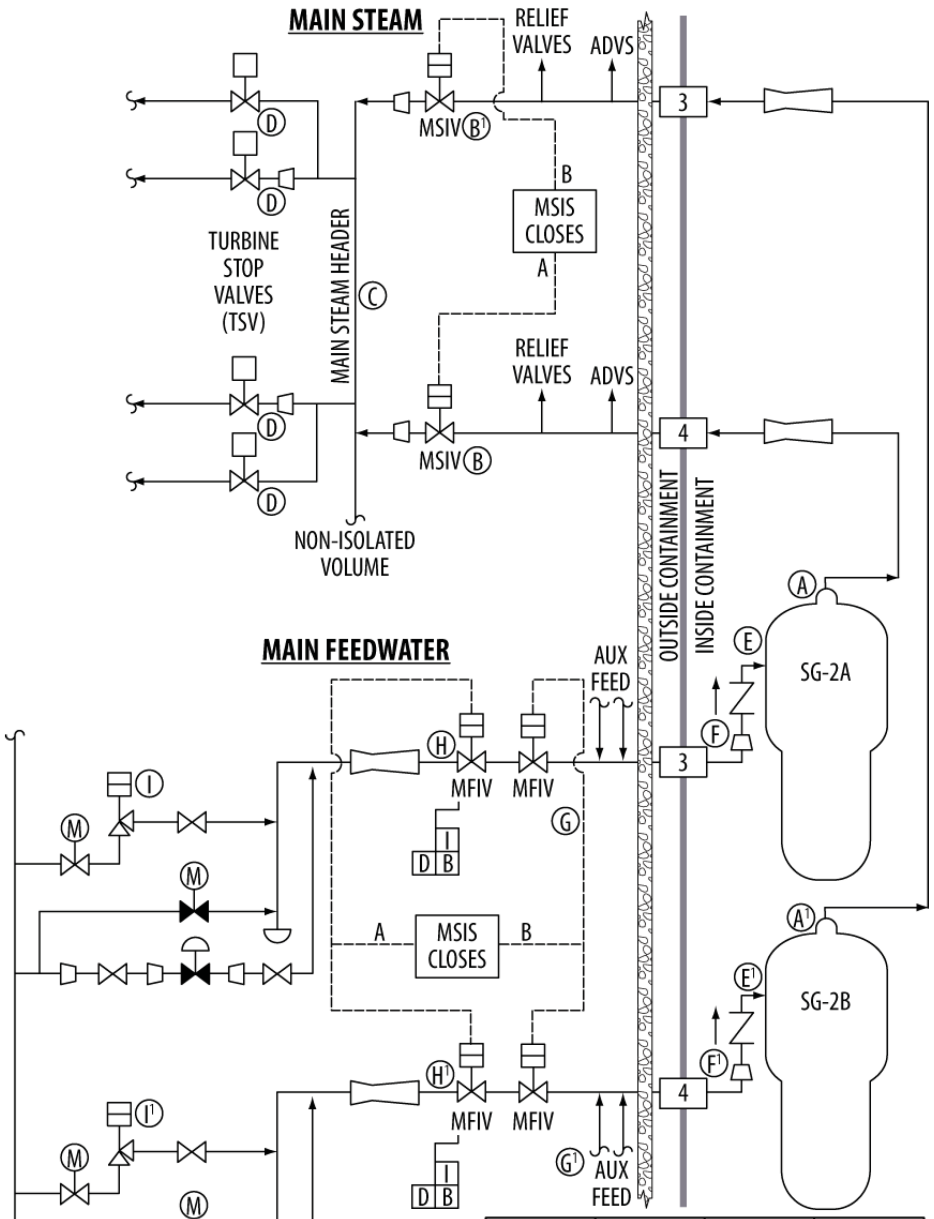
FIGURE 6.2–31



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

STANDARD FISSION PRODUCT DECAY HEAT CURVE (SH.2)

FIGURE 6.2–32

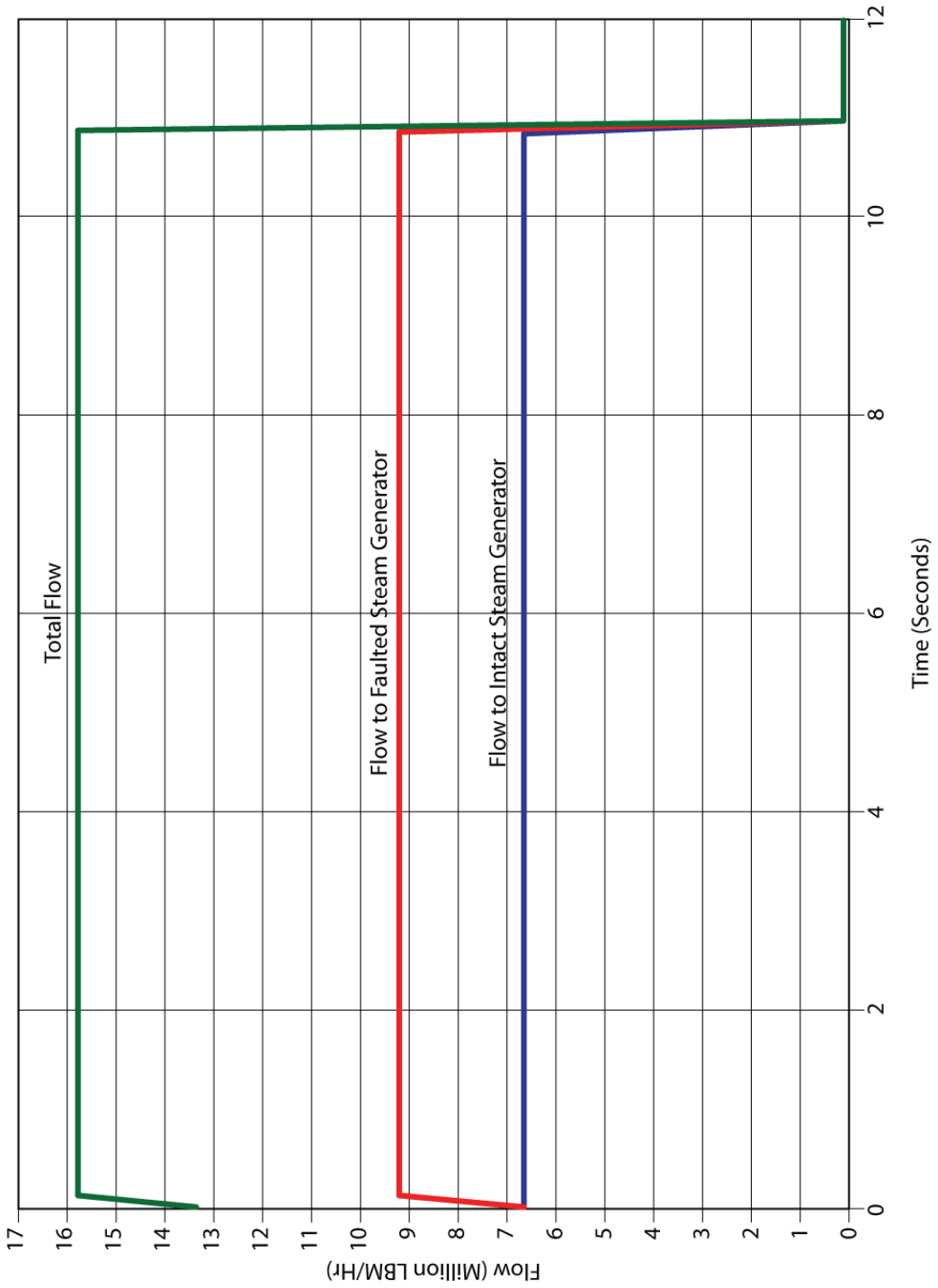


A-B	1432	A1-B1	1432
MSIV'S to TSV'S - 5663 Including Non-Isolated Volume			
E-F	24.51	E1-F1	24.51
F-G	231.23	F1-G1	231.23
Aux Feed	3.30	Aux Feed	3.30
G-H	21.03	G1-H1	21.03
H-J	363.40	H1-J1	378.30
Inc. Non-isolated Volume		Inc. Non-isolated Volume	

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

MAIN STEAM & MAIN FEEDWTR. PIPING SCHEMATIC & VOLUMES
FIGURE 6.2-33

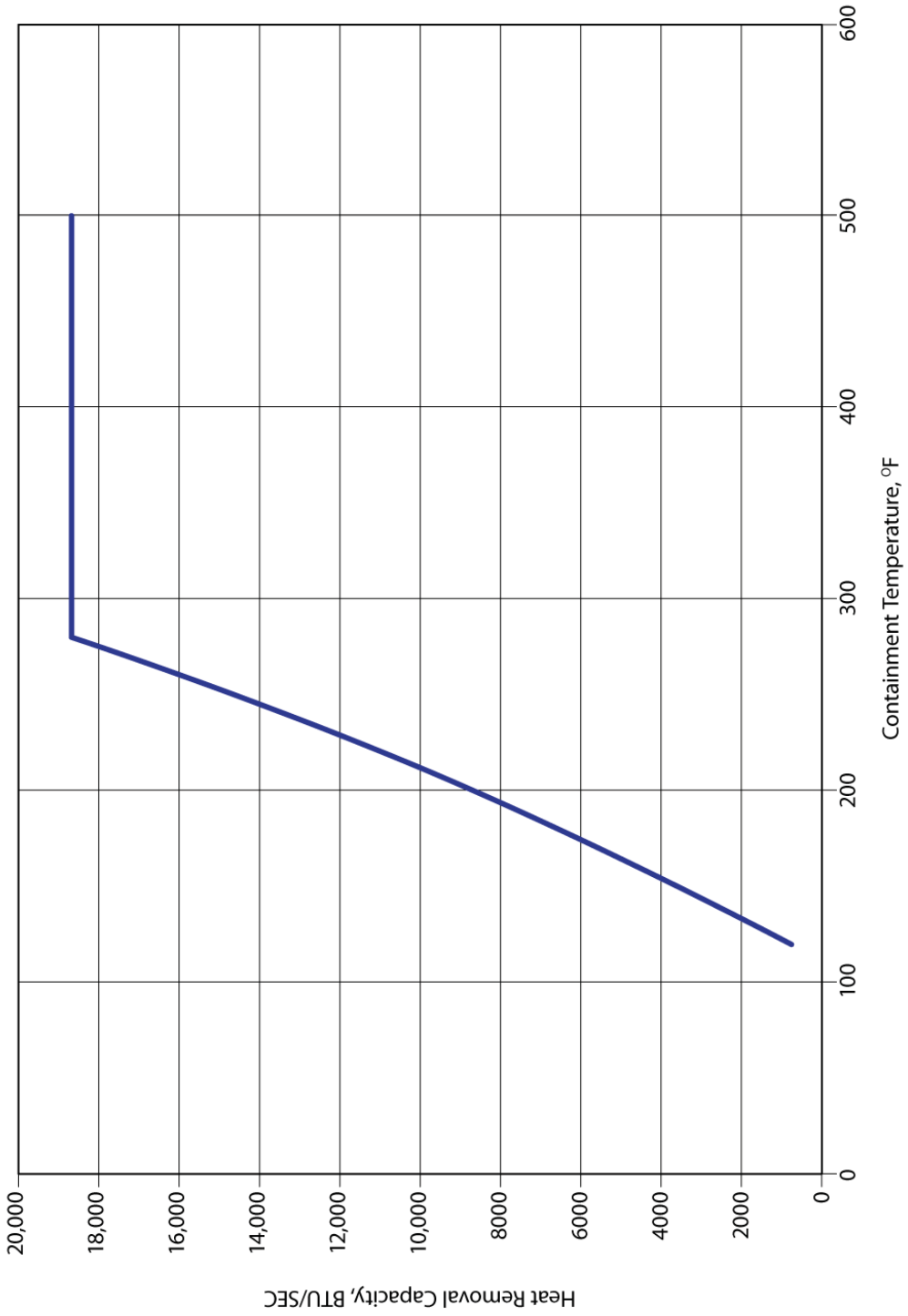
Amendment No. 21 (11/12)



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

FEEDWATER FLOW CURVES
102% POWER
FIGURE 6.2-34

Amendment No. 21 (11/12)



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

HEAT REMOVAL CAPACITY OF A CONTAINMENT FAN COOLER
FIGURE 6.2-35

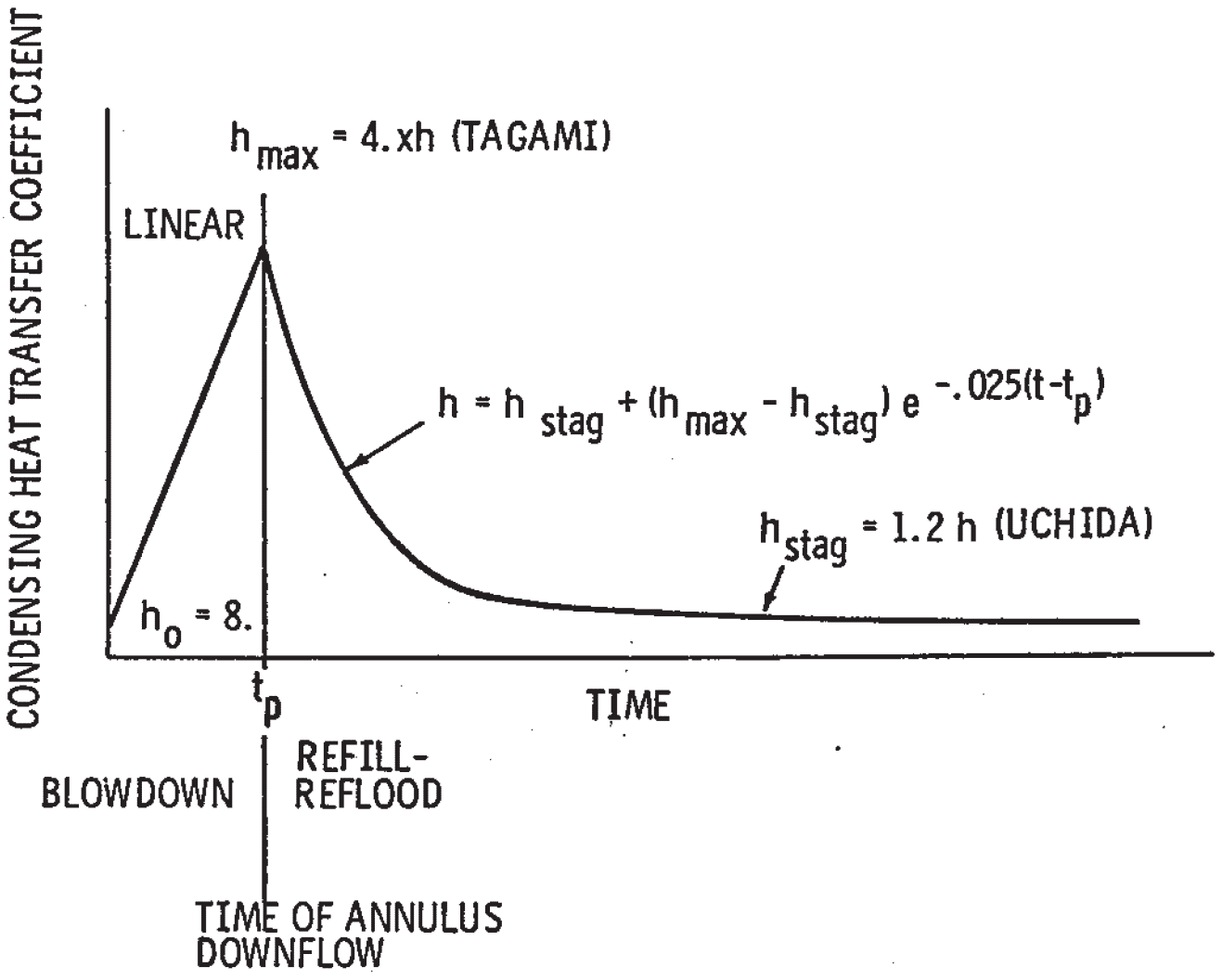
Amendment No. 21 (11/12)

DELETED

AMENDMENT N0. 8 (9/93)

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

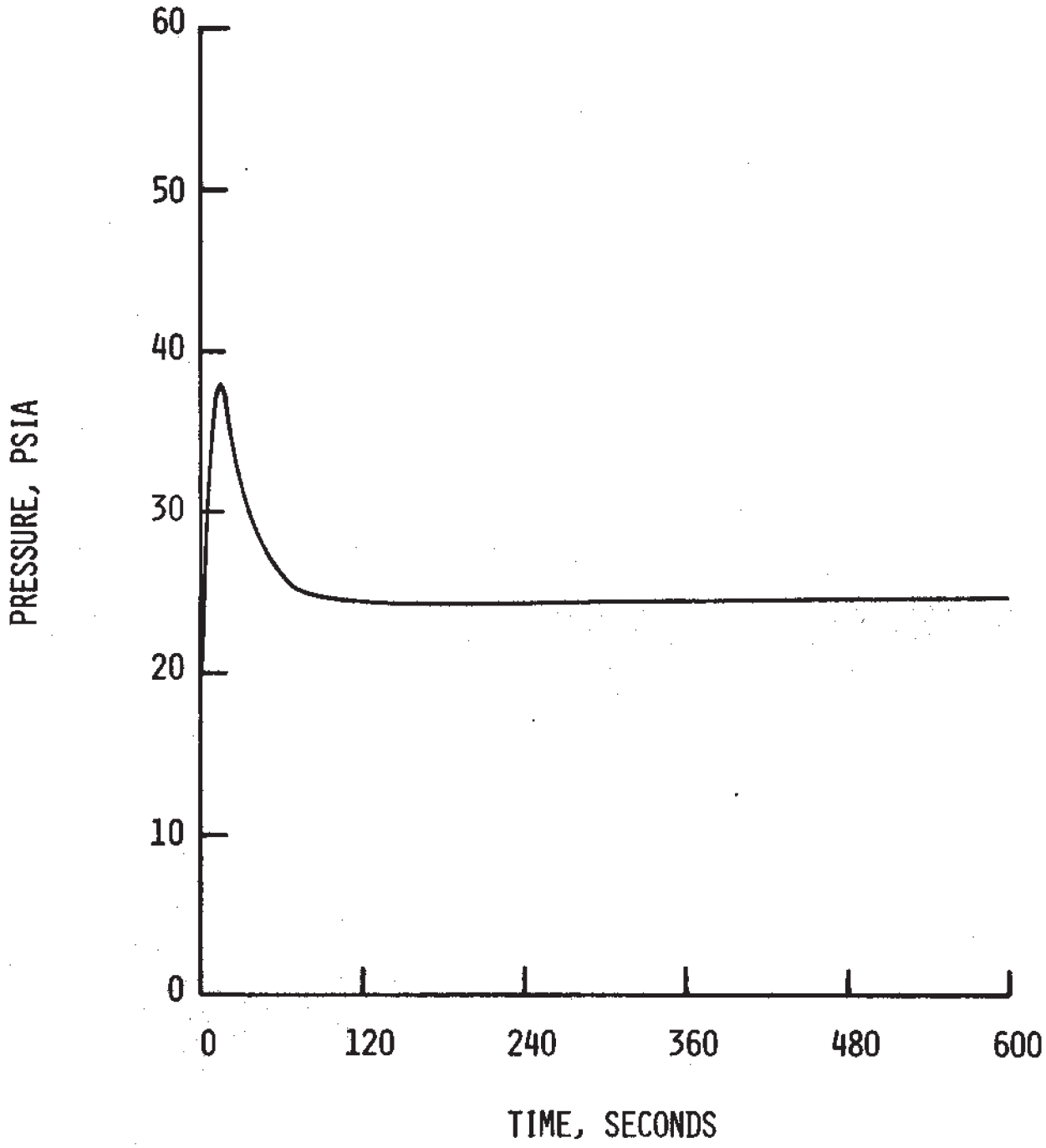
FIGURE 6.2-36



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

CONDENSING HEAT TRANSFER COEFF.
FOR STATIC HEAT SINKS

FIGURE 6.2–37

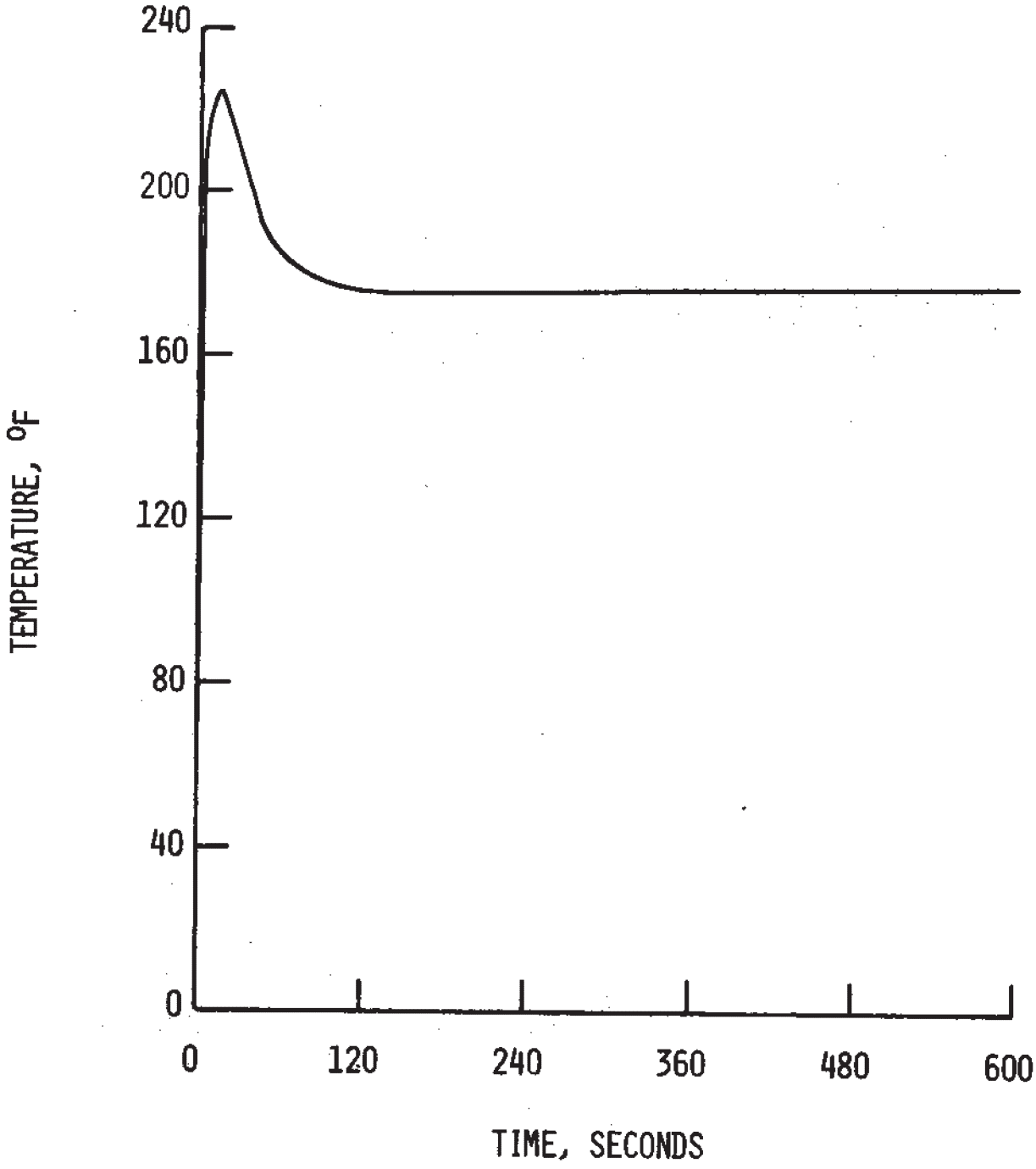


NOTE: 1.0 X DOUBLE ENDED GUILLOTINE BREAK IN PUMP DISCHARGE LEG

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

MIN. CONTAINMENT PRESSURE RESPONSE FOR ECCS PERFORMANCE ANALYSIS

FIGURE 6.2–38

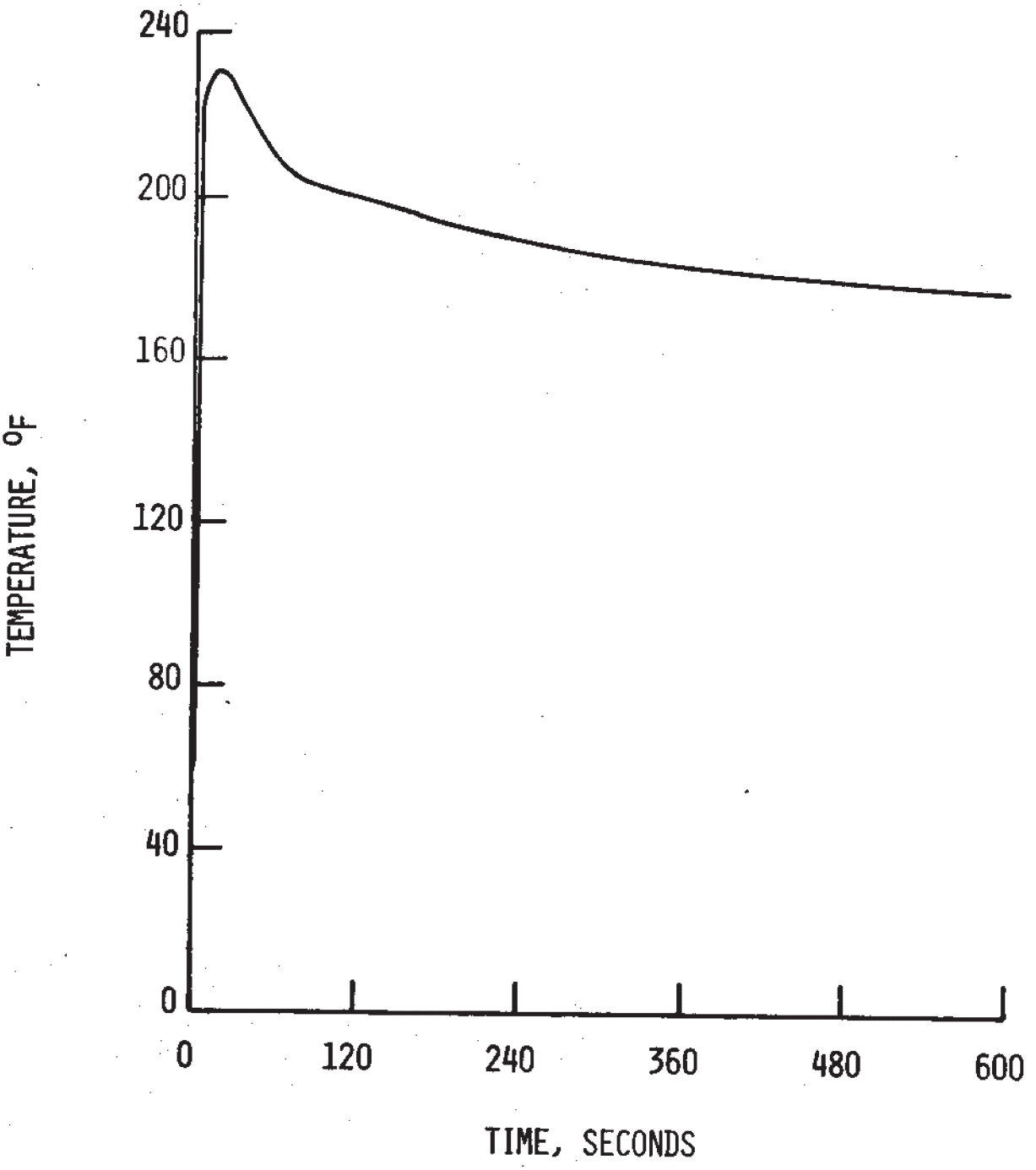


NOTE: 1.0 X DOUBLE ENDED GUILLOTINE BREAK IN PUMP DISCHARGE LEG

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

CONTAINMENT ATMOSPHERE TEMP. RESPONSE FOR ECCS PERF. ANALYSIS

FIGURE 6.2–39



NOTE: 1.0 X DOUBLE ENDED GUILLOTINE BREAK IN PUMP DISCHARGE LEG

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

CONTAINMENT SUMP TEMP. RESPONSE FOR ECCS PERFORMANCE ANALYSIS

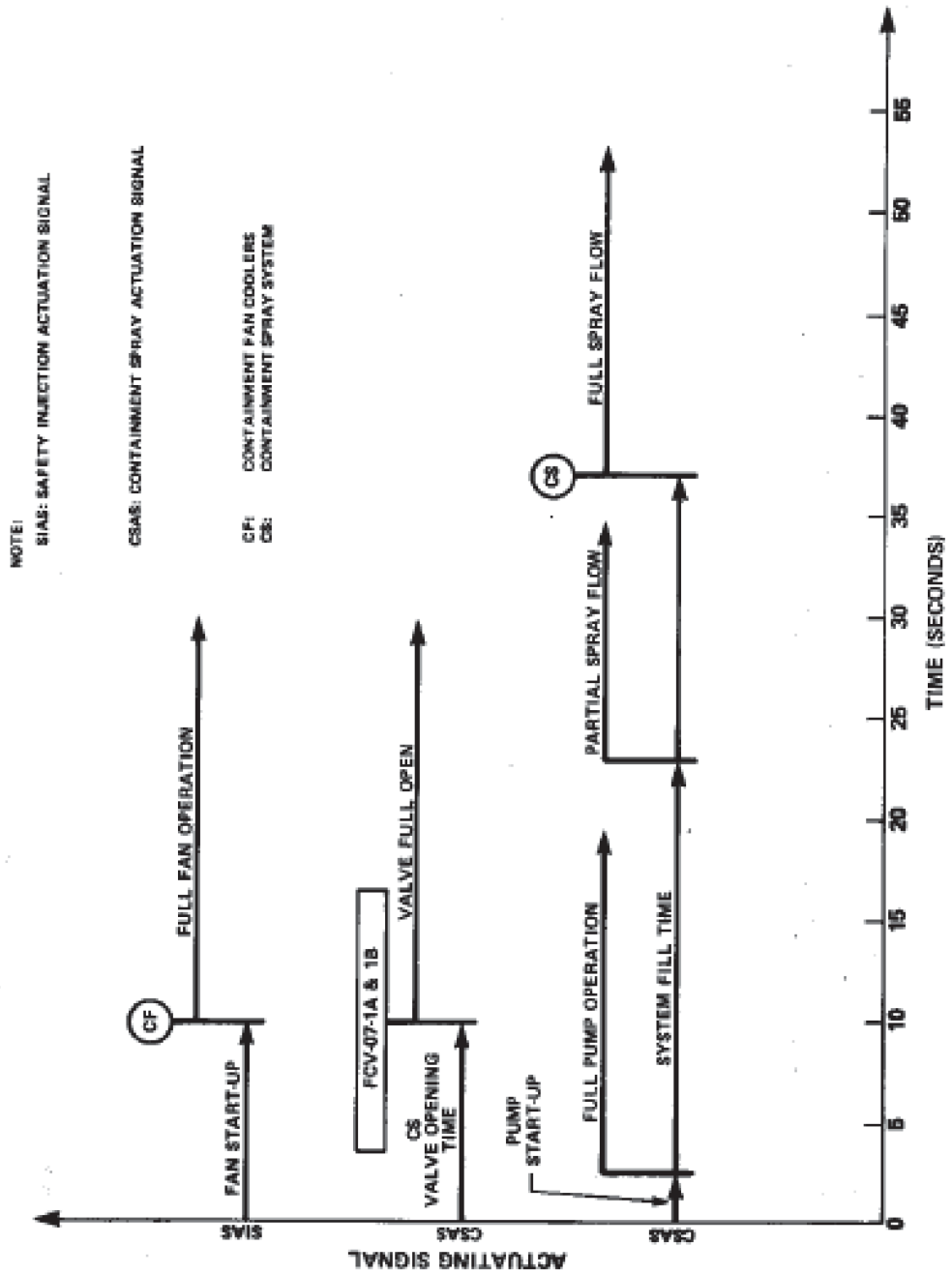
FIGURE 6.2–40

Refer to Dwg.
2998-G-088, Sh. 1 & 2

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

FLOW DIAGRAM
CONTAINMENT SPRAY AND
REFUELING WATER SYSTEMS
FIGURE 6.2-41

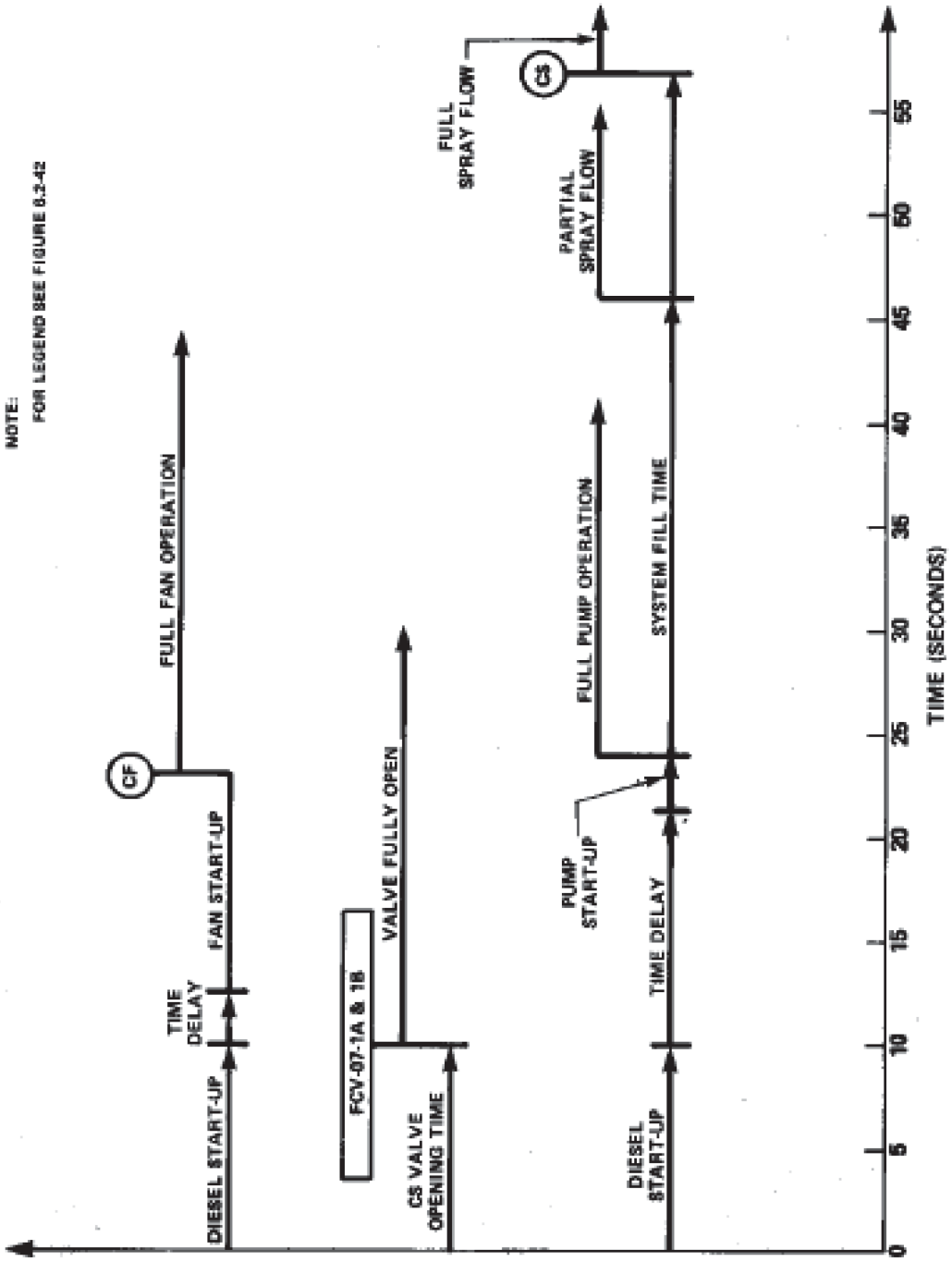
AMENDMENT NO. 10, (7/96)



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

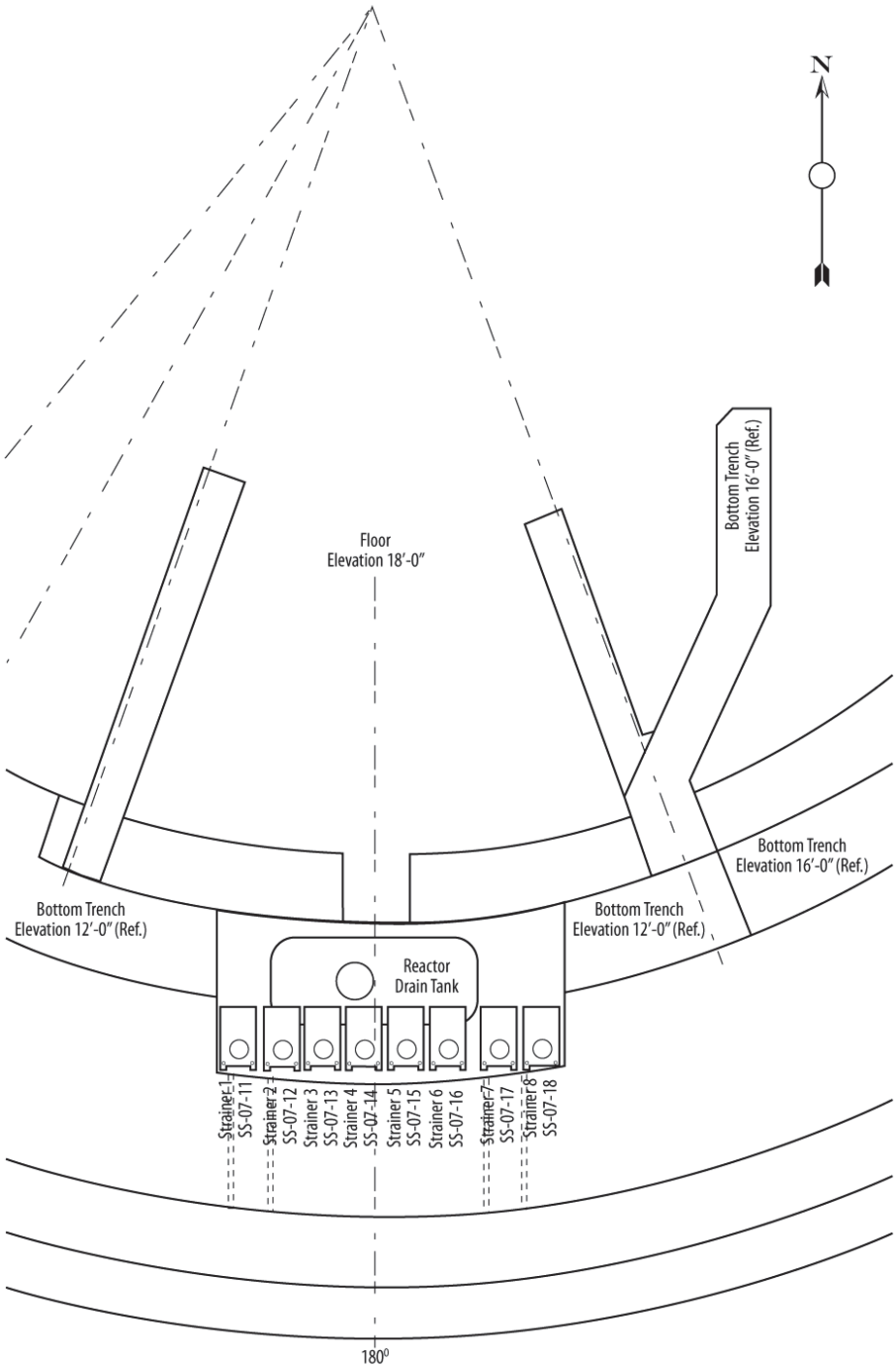
ACCIDENT LOGIC SEQUENCE
(OFF-SITE POWER AVAILABLE)
(HISTORICAL)
FIGURE 6.2-42

Amendment No. 21 (11/12)



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

ACCIDENT LOGIC SEQUENCE
(LOSS OF OFF-SITE POWER)
(HISTORICAL)
FIGURE 6.2-43



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SUMP SCREEN FOR EMERGENCY CORE COOLING AND CONTAINMENT SPRAY SYSTEM
FIGURE 6.2-44

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FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

FIGURE 6.2-45

Refer to Drawing
2998-G-864

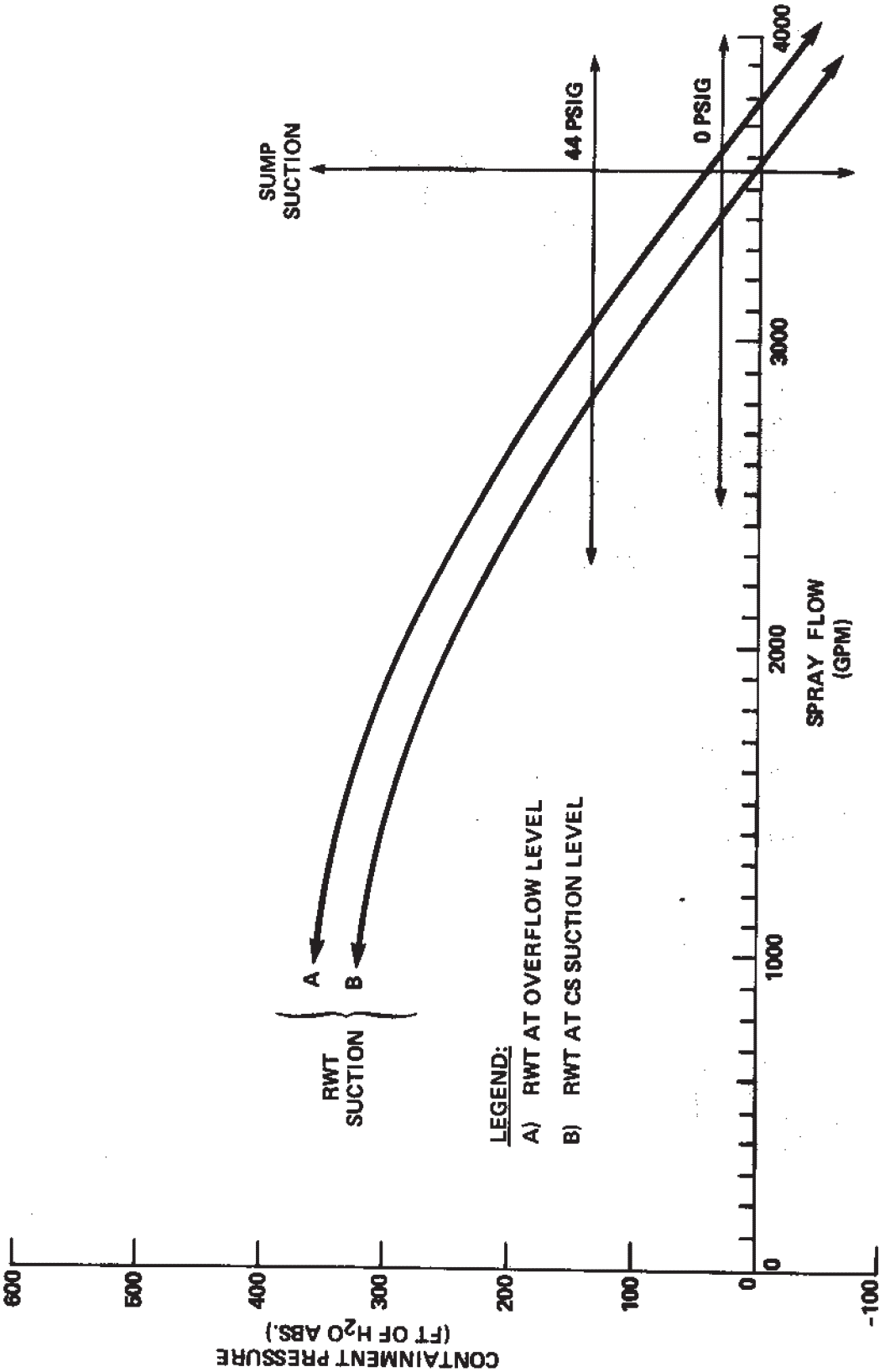
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

HVAC -
REACTOR BUILDING -
SHEET 1
FIGURE 6.2-46

Refer to Drawing
2998-G-865

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

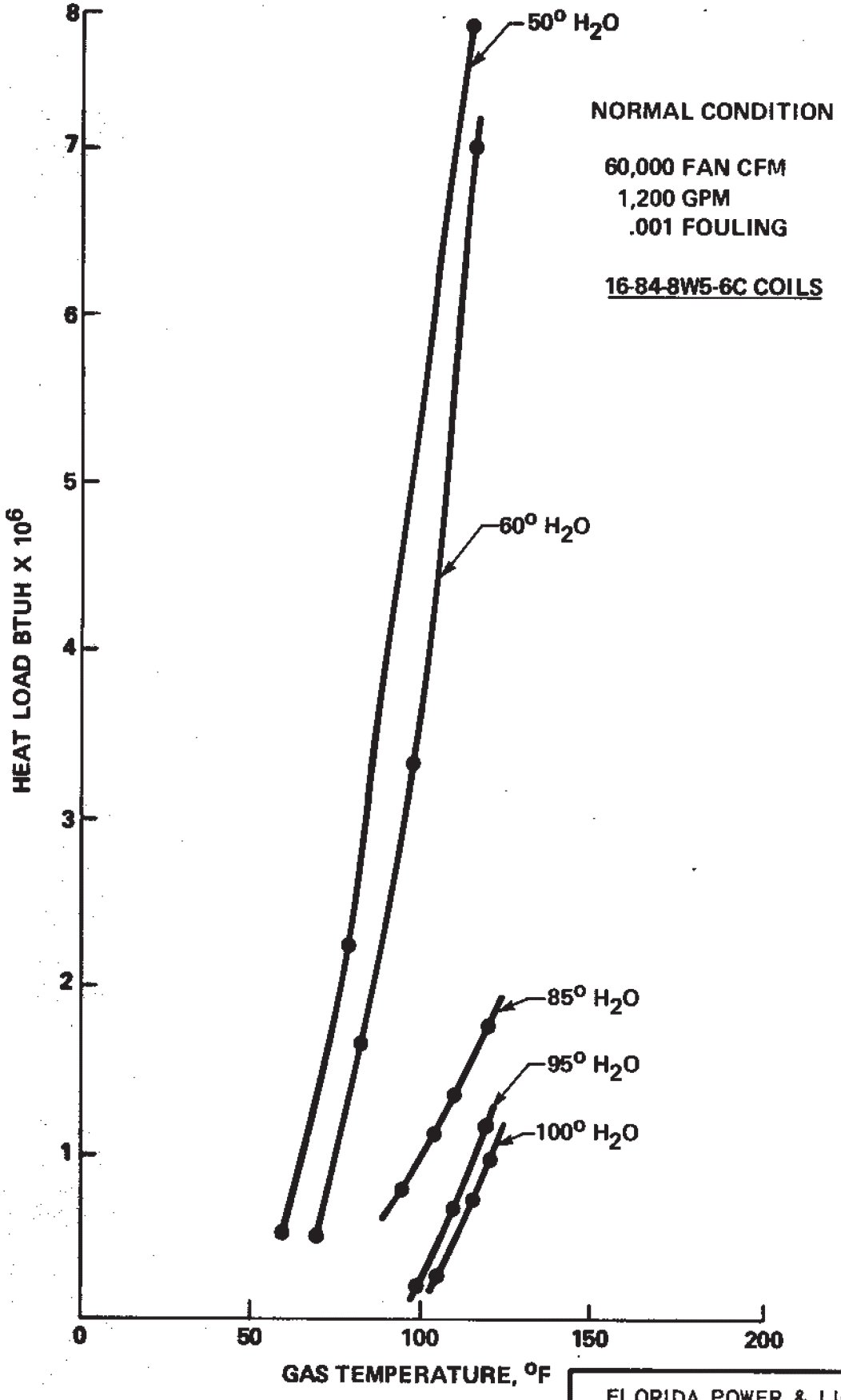
HVAC -
REACTOR BUILDING -
SHEET 2
FIGURE 6.2-47



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

PERFORMANCE OF CONTAINMENT SPRAY SYSTEM

FIGURE 6.2-48

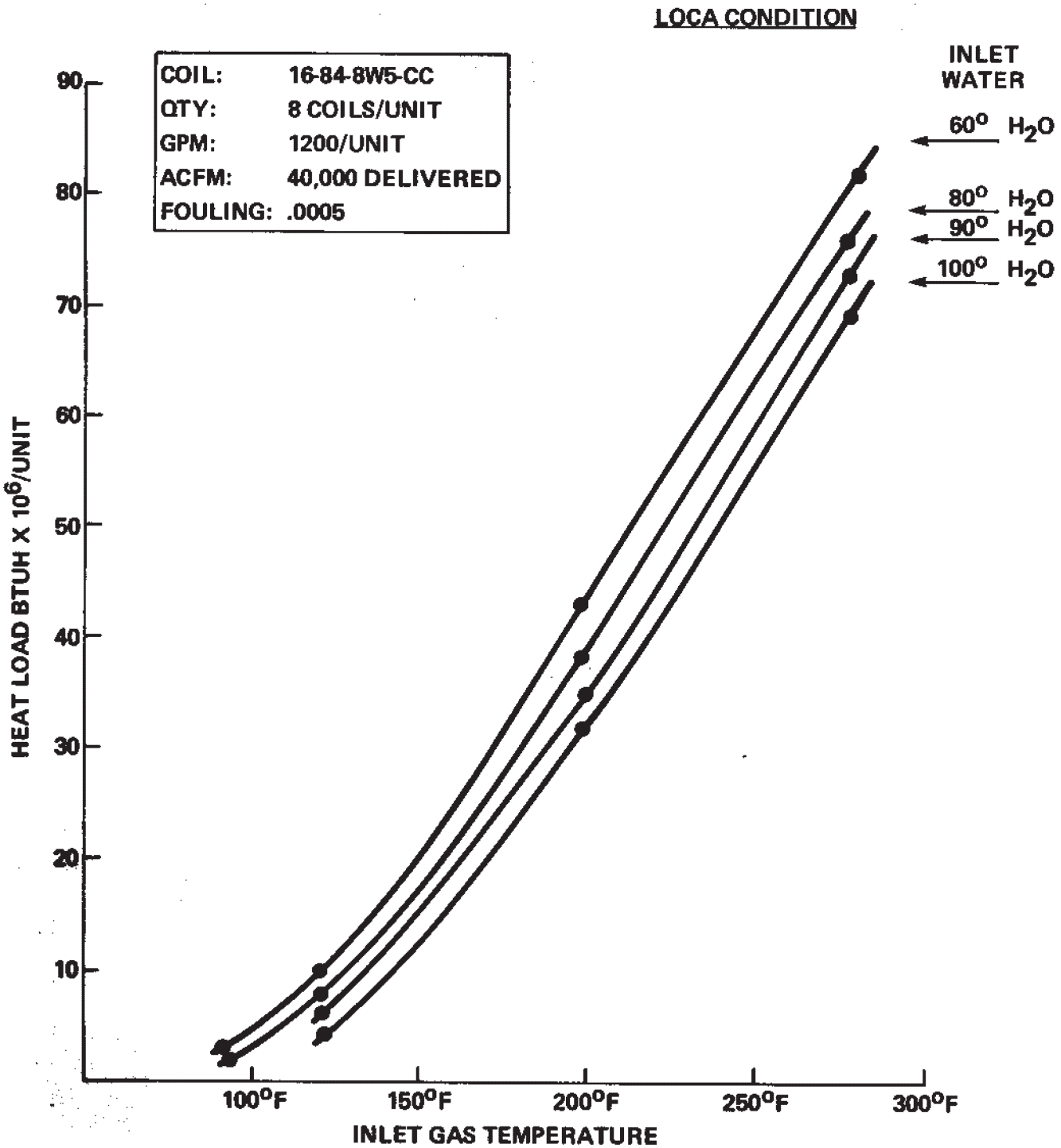


FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

CONTAINMENT COOLING SYSTEM
NORMAL PULLDOWN

FIGURE 6.2-49

REF DWG: SK-91-1317-2 (REV. 0)



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

CONTAINMENT COOLING SYSTEM
EMERGENCY PULLDOWN

FIGURE 6.2-50

REF DWG: SK-91-1317-1 (REV. 1)

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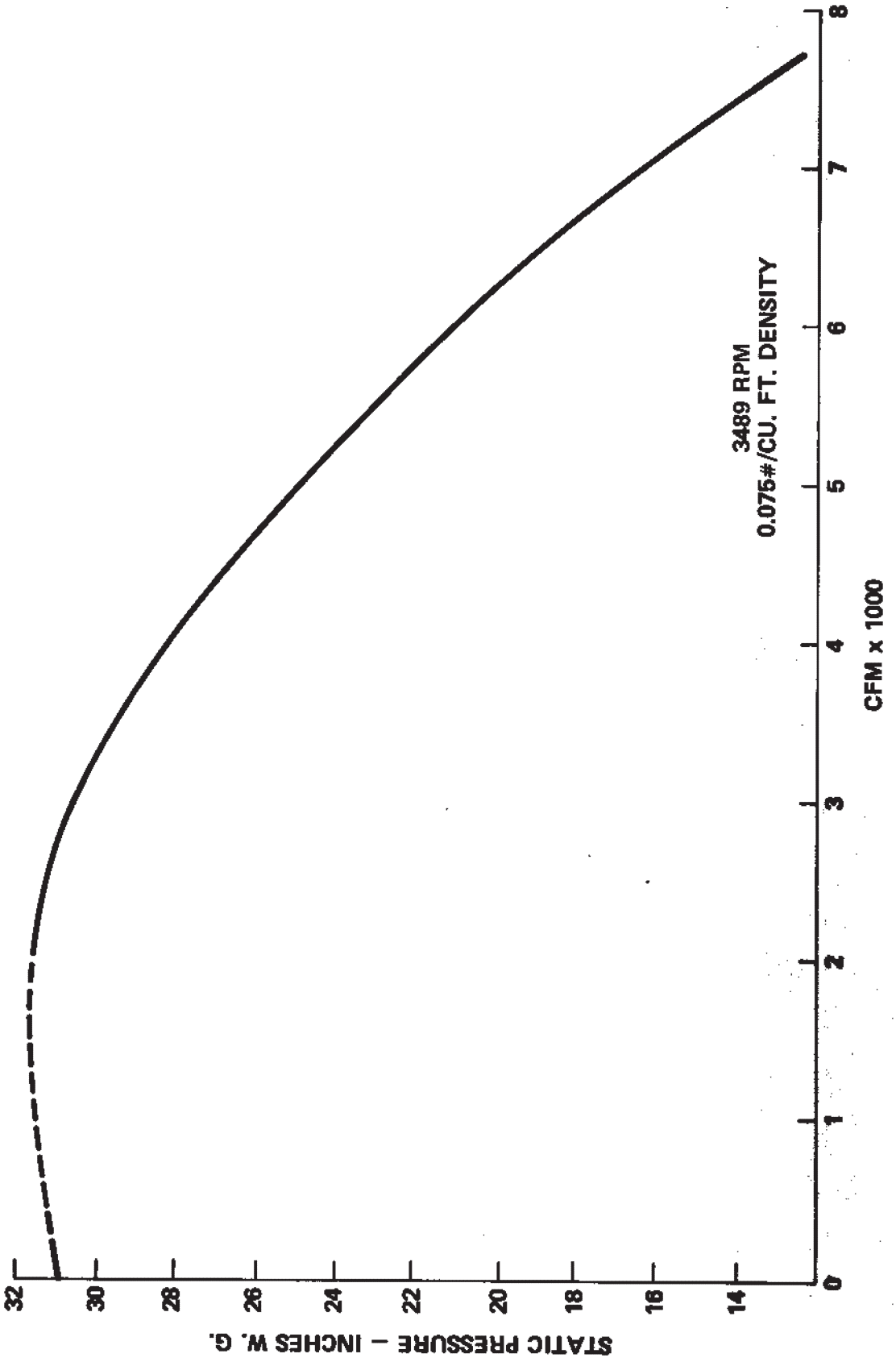
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

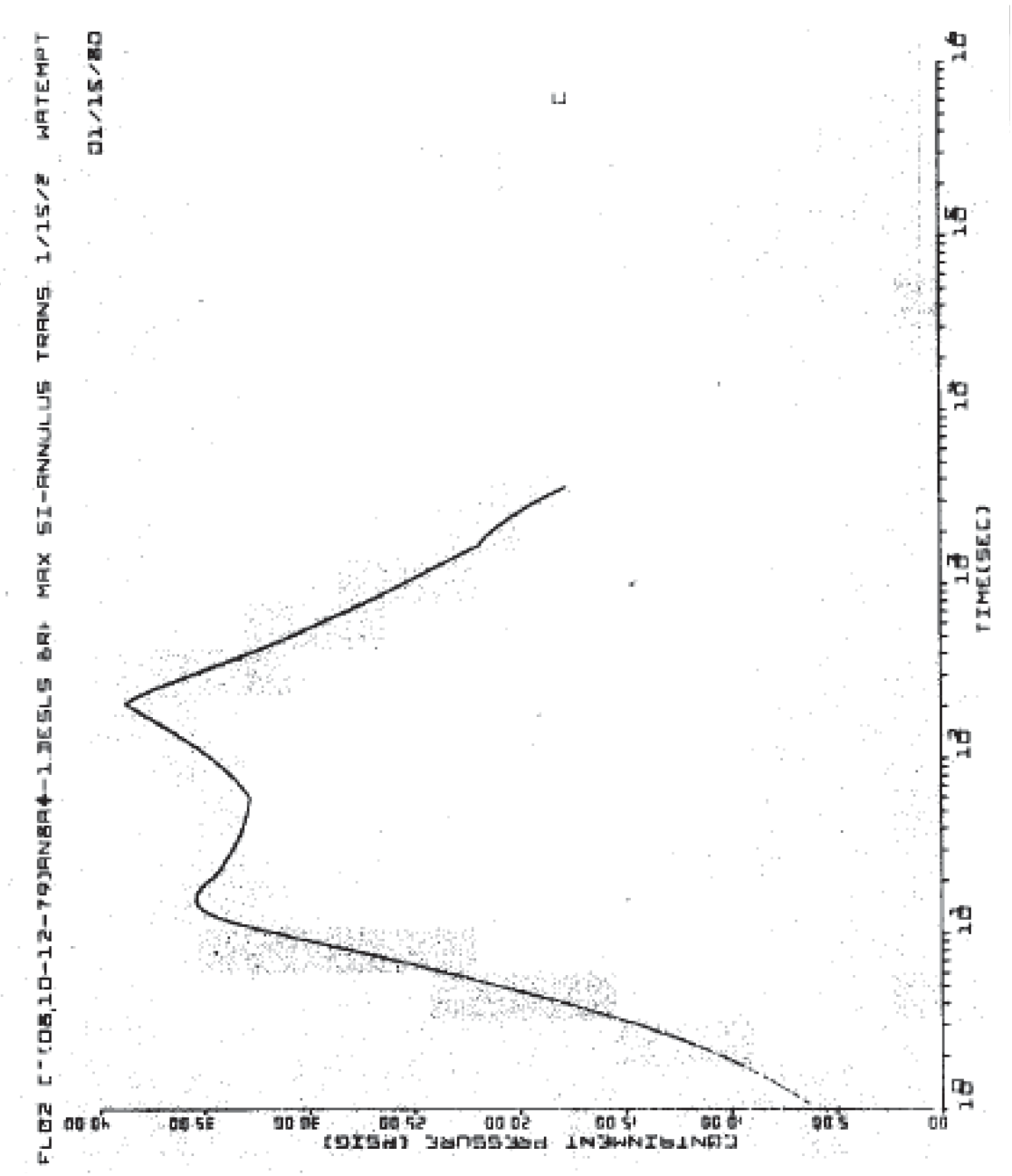
FIGURE 6.2-51



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SBVS FAN PERFORMANCE CURVE

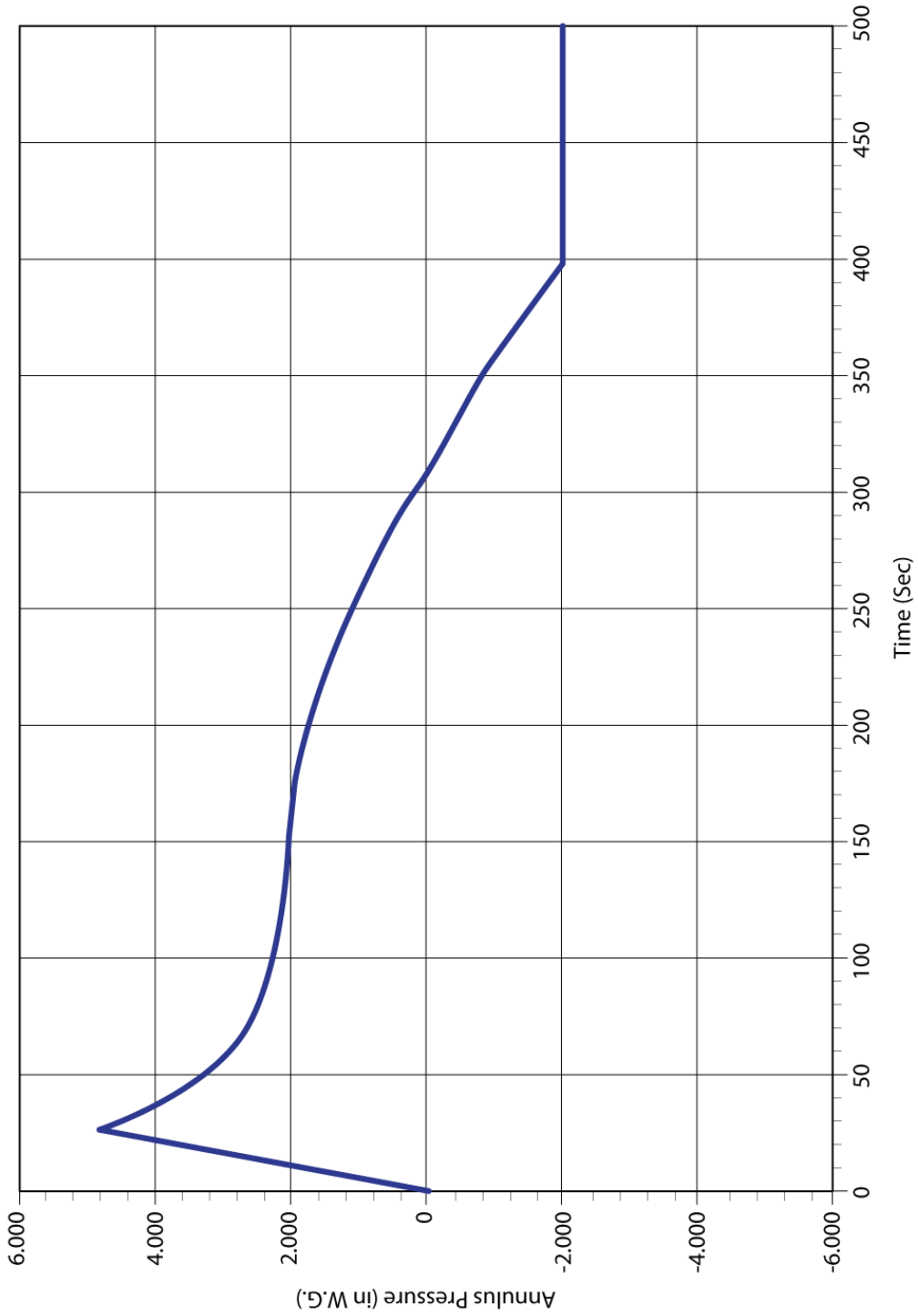
FIGURE 6.2-52



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

Pre-EPU CONTAINMENT PRESSURE FOR SHIELD BLDG. ANNULUS TRANSIENT FOLLOWING A 9.82 FT^2 DESLS (HISTORICAL)

FIGURE 6.2-53



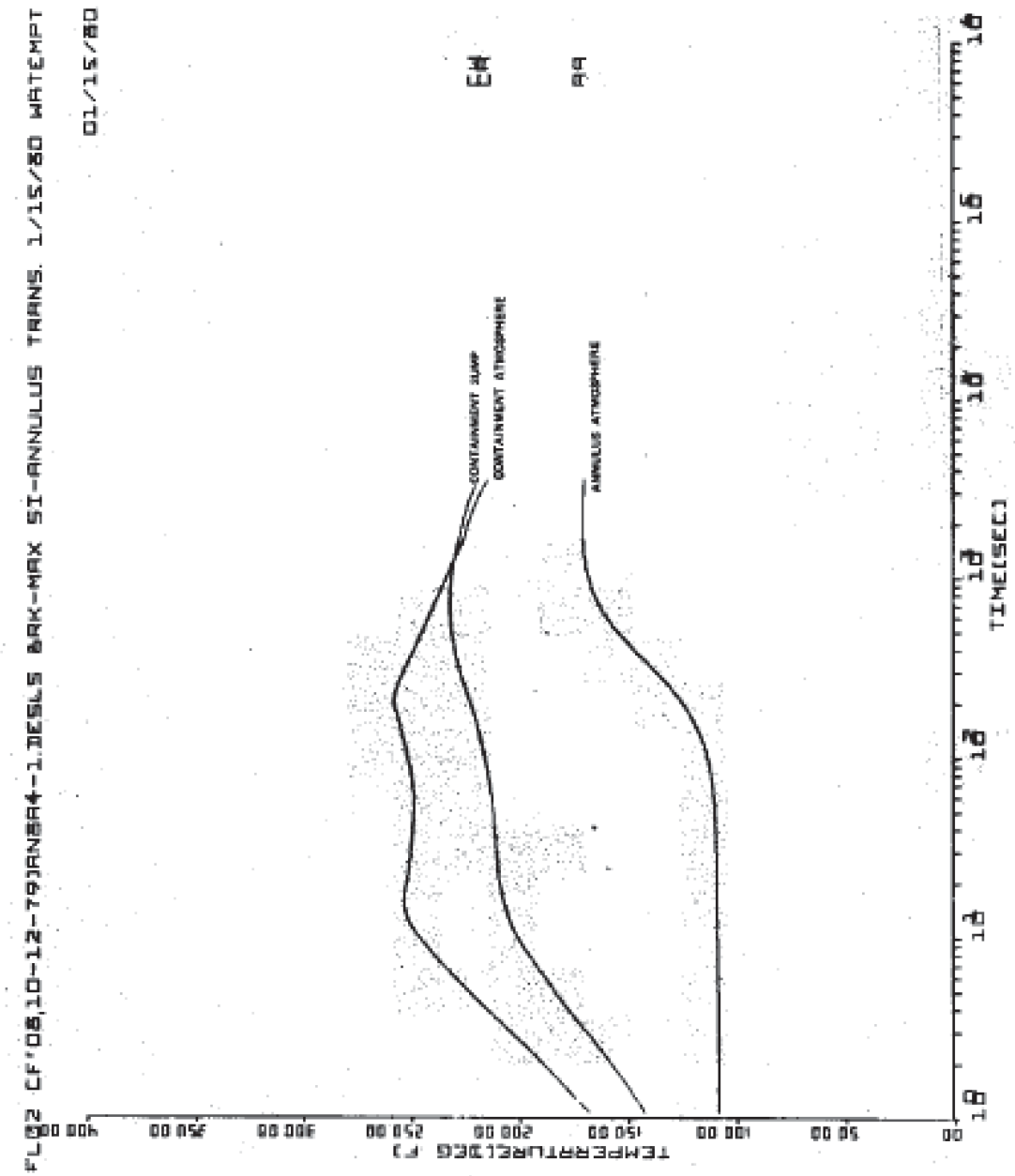
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SHIELD BLDG. ANNULUS PRESSURE
FOR THE LIMITING LOCA CASE (DEHLS)
FIGURE 6.2-54

FIGURE 6.2-55 HAS BEEN DELETED

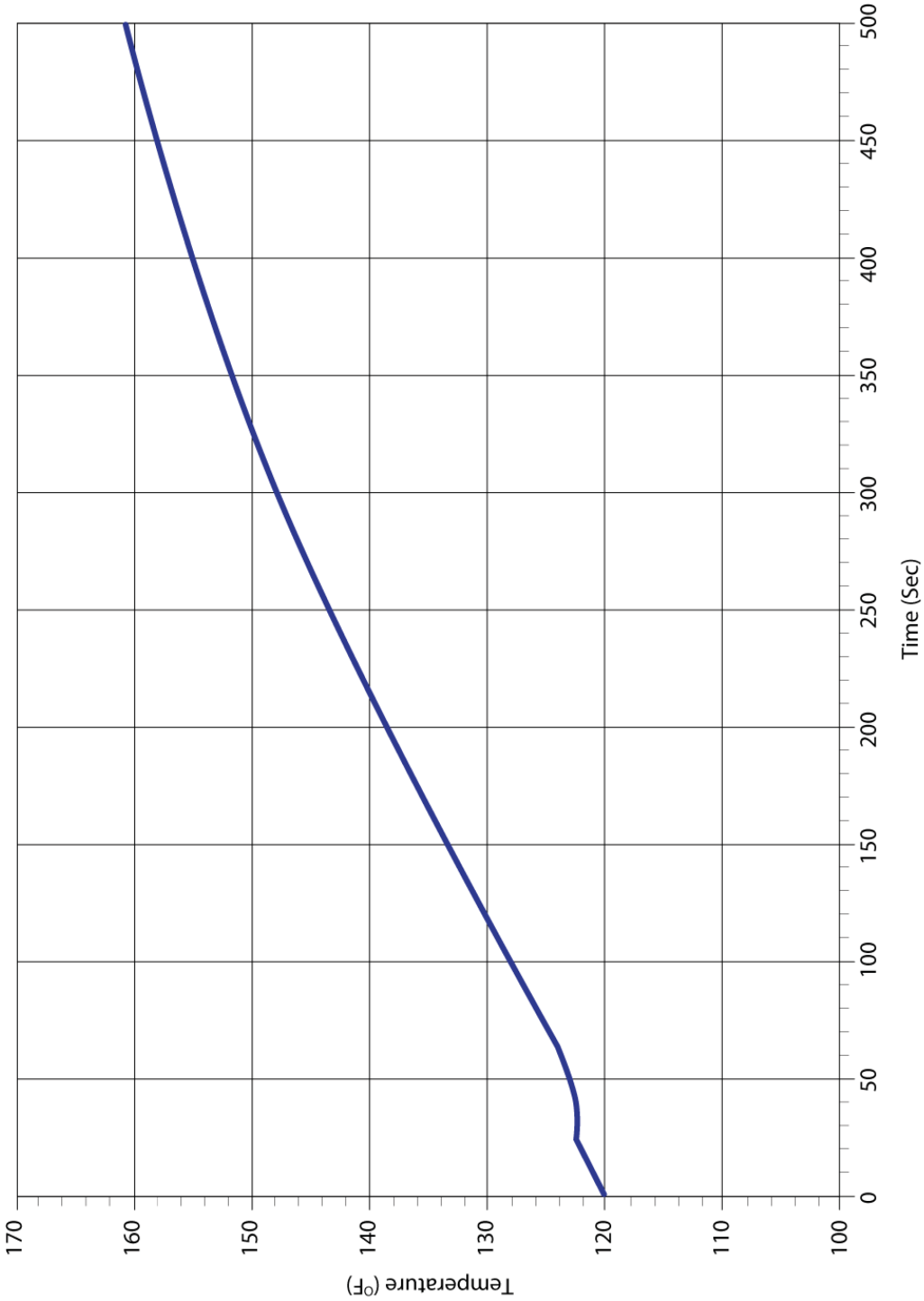
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SHIELD BLDG. ANNULUS PRESSURE
FOLLOWING A 9.82 FT^2 DESLS- SH.2
FIGURE 6.2-55



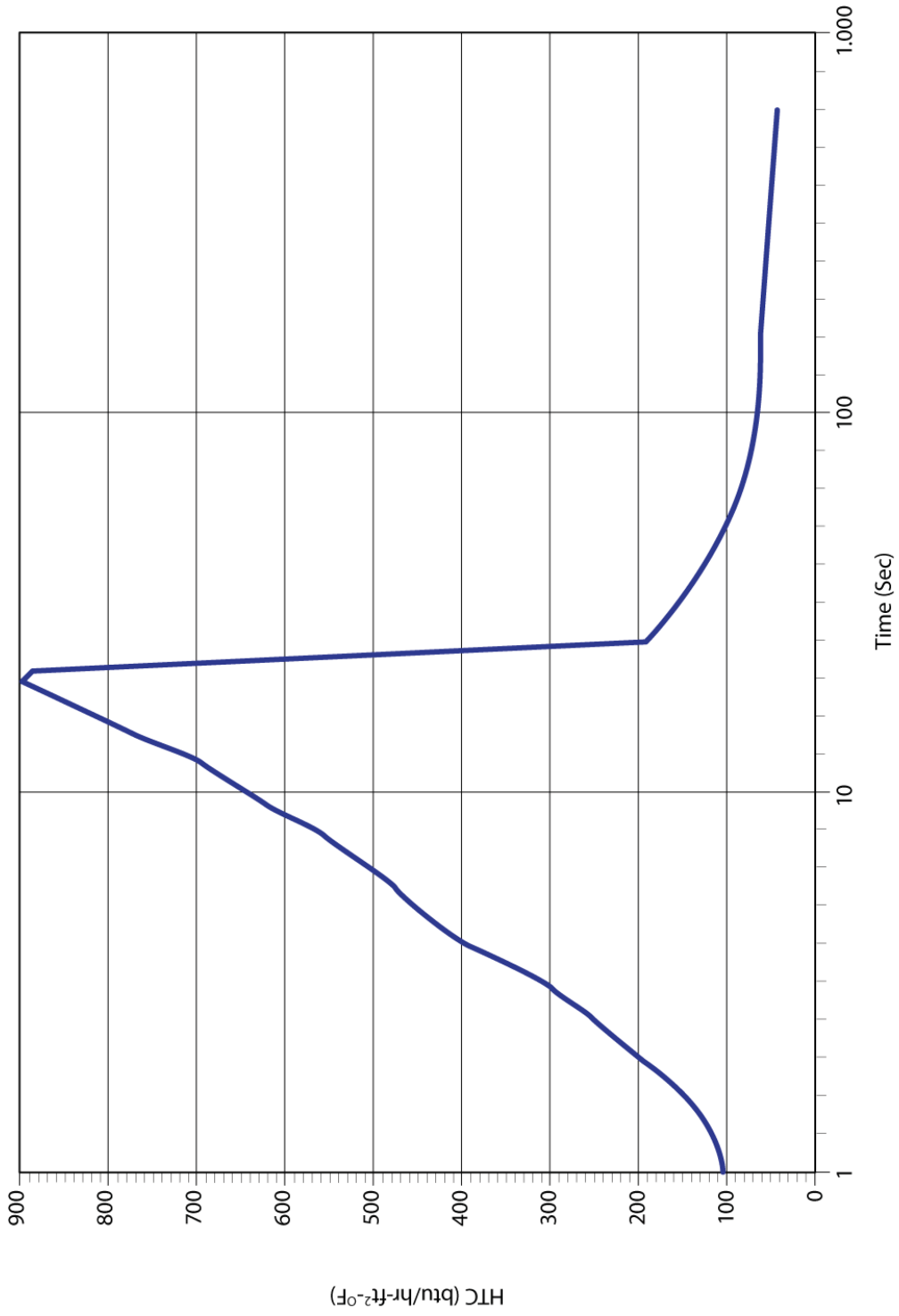
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

Pre-EPU CONTAINMENT & SHIELD BLDG. ANNULUS TEMP FOLLOWING A 9.82 FT^2 DESLS
(HISTORICAL)
FIGURE 6.2-56



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SHIELD BUILDING ANNULUS TEMPERATURE FOR THE LIMITING LOCA CASE (DEHLS)
FIGURE 6.2-56a



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

CONTAINMENT VESSEL SURFACE TEMP.
AS A FUNCTION OF TIME
FIGURE 6.2-57

Amendment No. 21 (11/12)

FIGURE 6.2-58 HAS BEEN DELETED

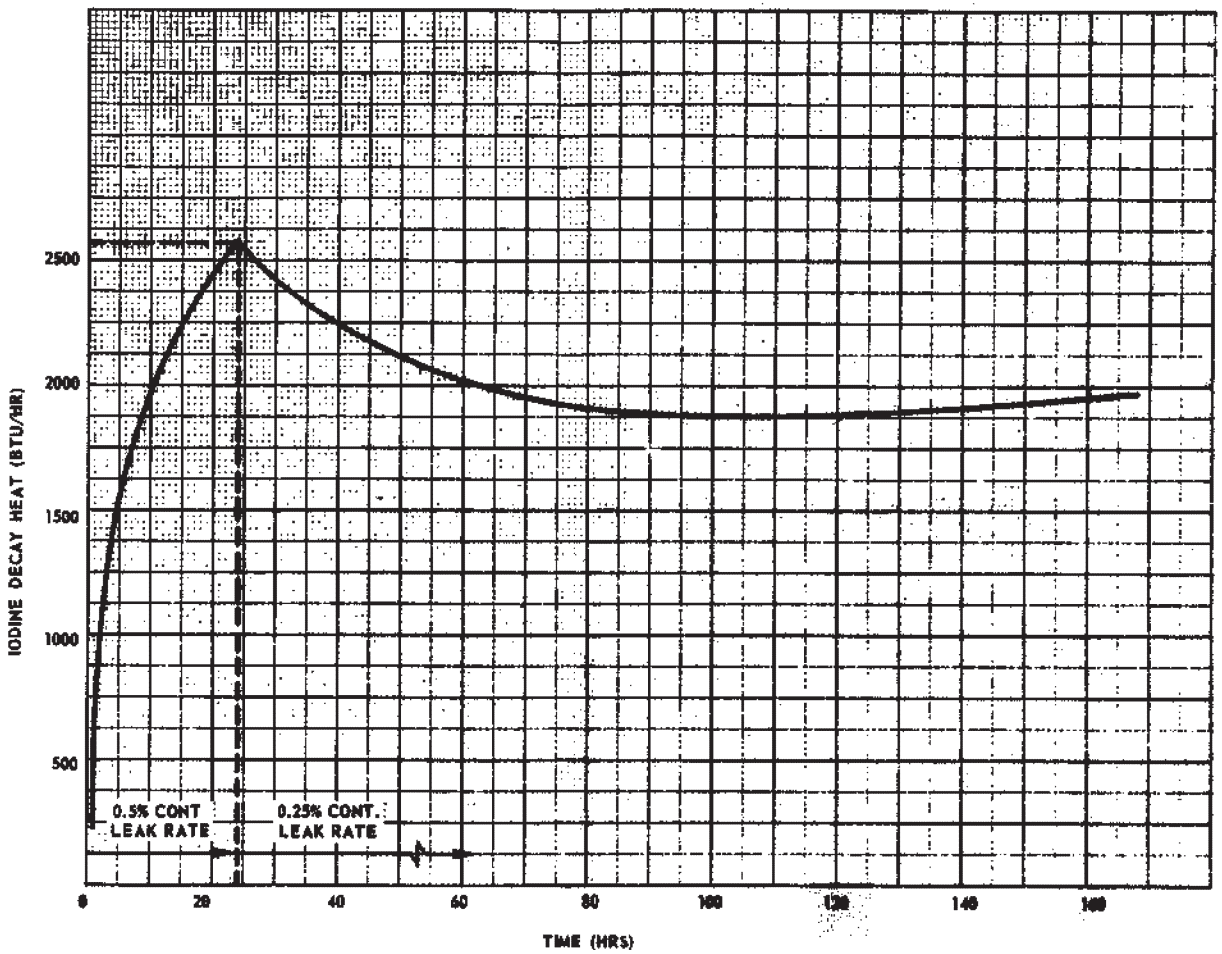
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

CONTAINMENT VESSEL TEMP.
GRADIENT AS A FUNCTION OF DISTANCE
& TIME
FIGURE 6.2-58

FIGURE 6.2-59 HAS BEEN DELETED

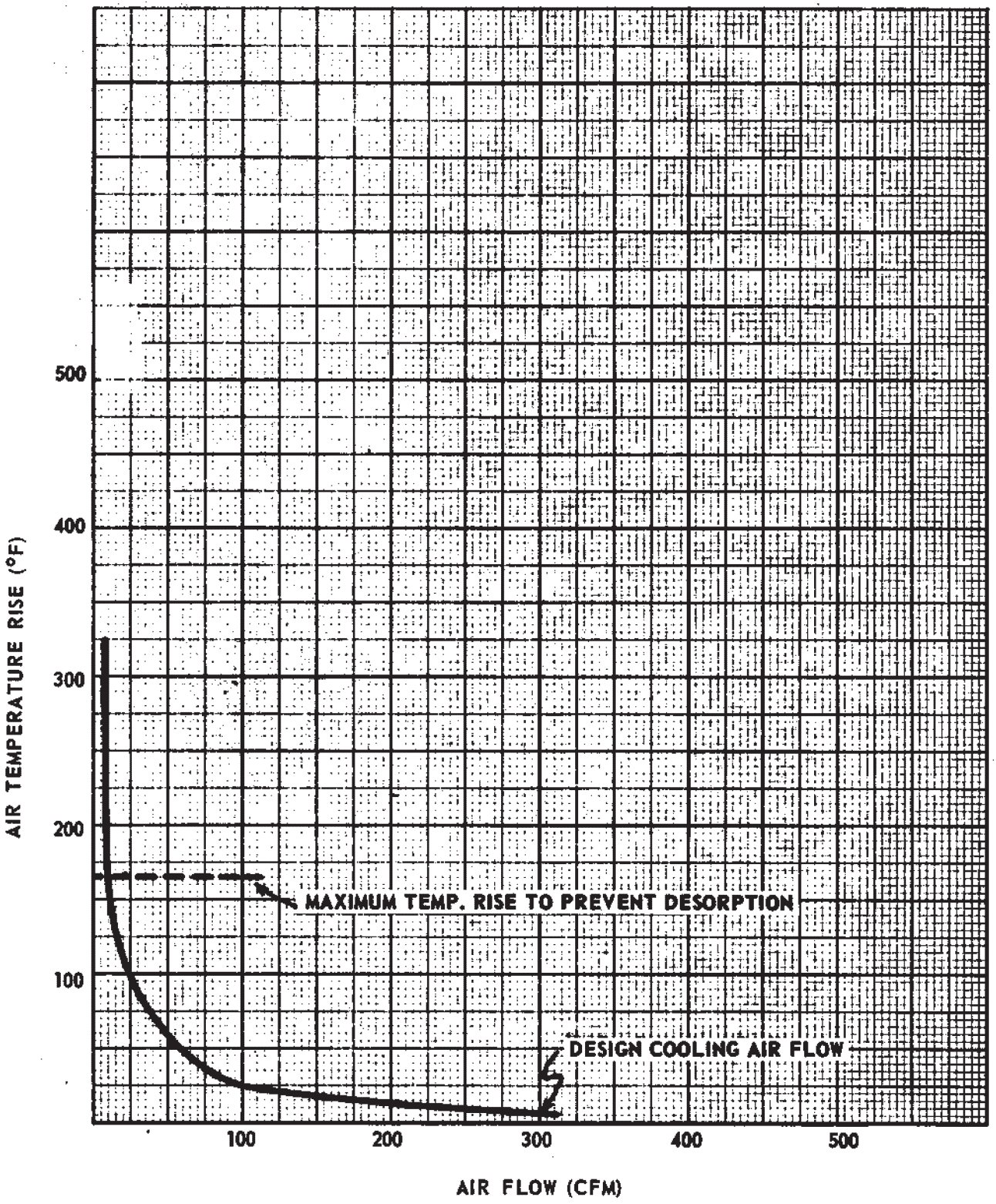
FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SHIELD BLDG. WALL SURFACE TEMP.
AS A FUNCTION OF TIME
FIGURE 6.2-59



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

SBVS CHARCOAL DECAY HEATING
VS TIME FOLLOWING DBA
FIGURE 6.2–60



NOTE: AT TIME OF MAXIMUM DECAY HEATING FOLLOWING DBA

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

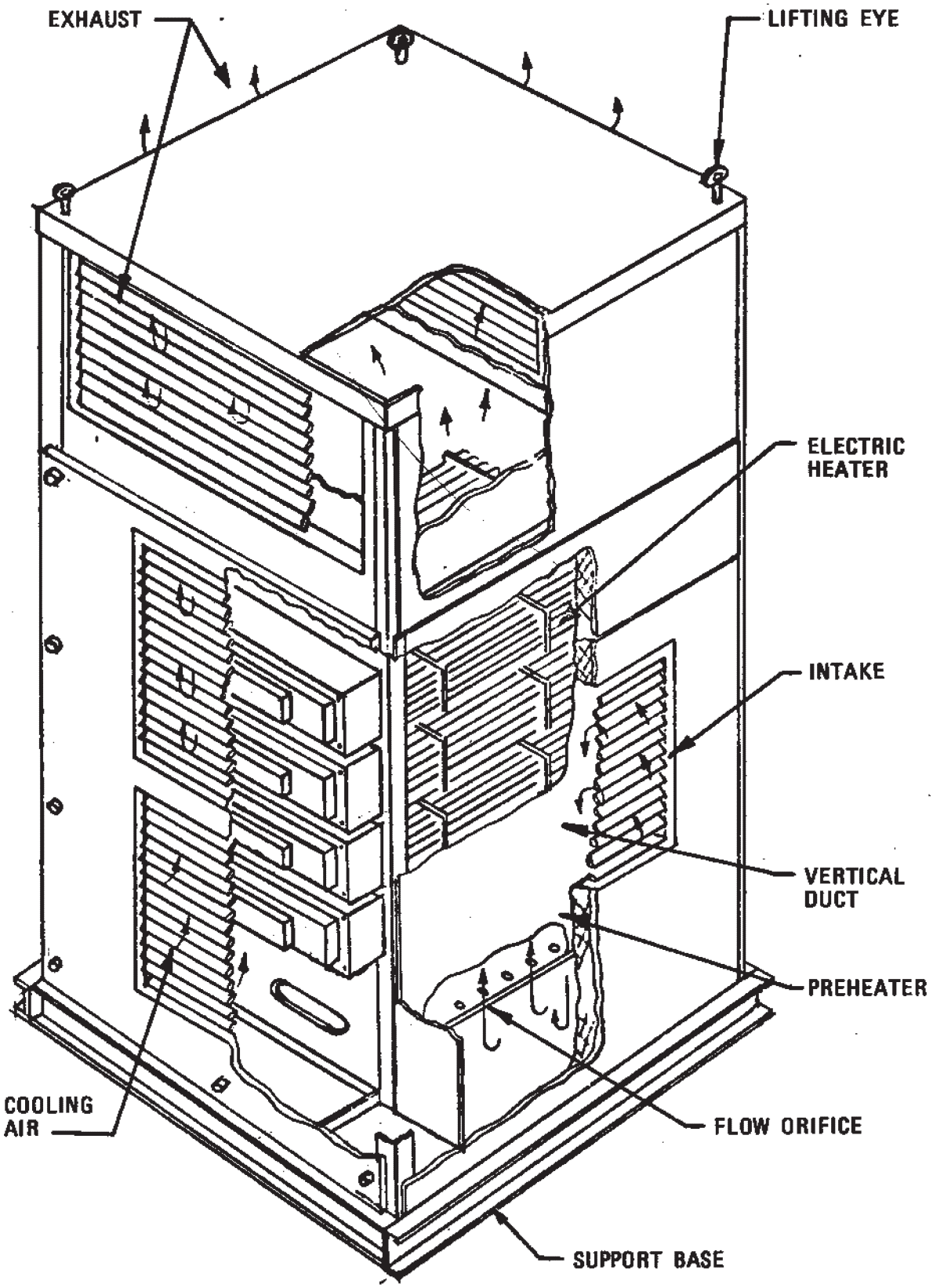
SBVS CHARCOAL ADSORBER AIR TEMP. RISE VS COOLING AIR FLOW

FIGURE 6.2-61

DELETED

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

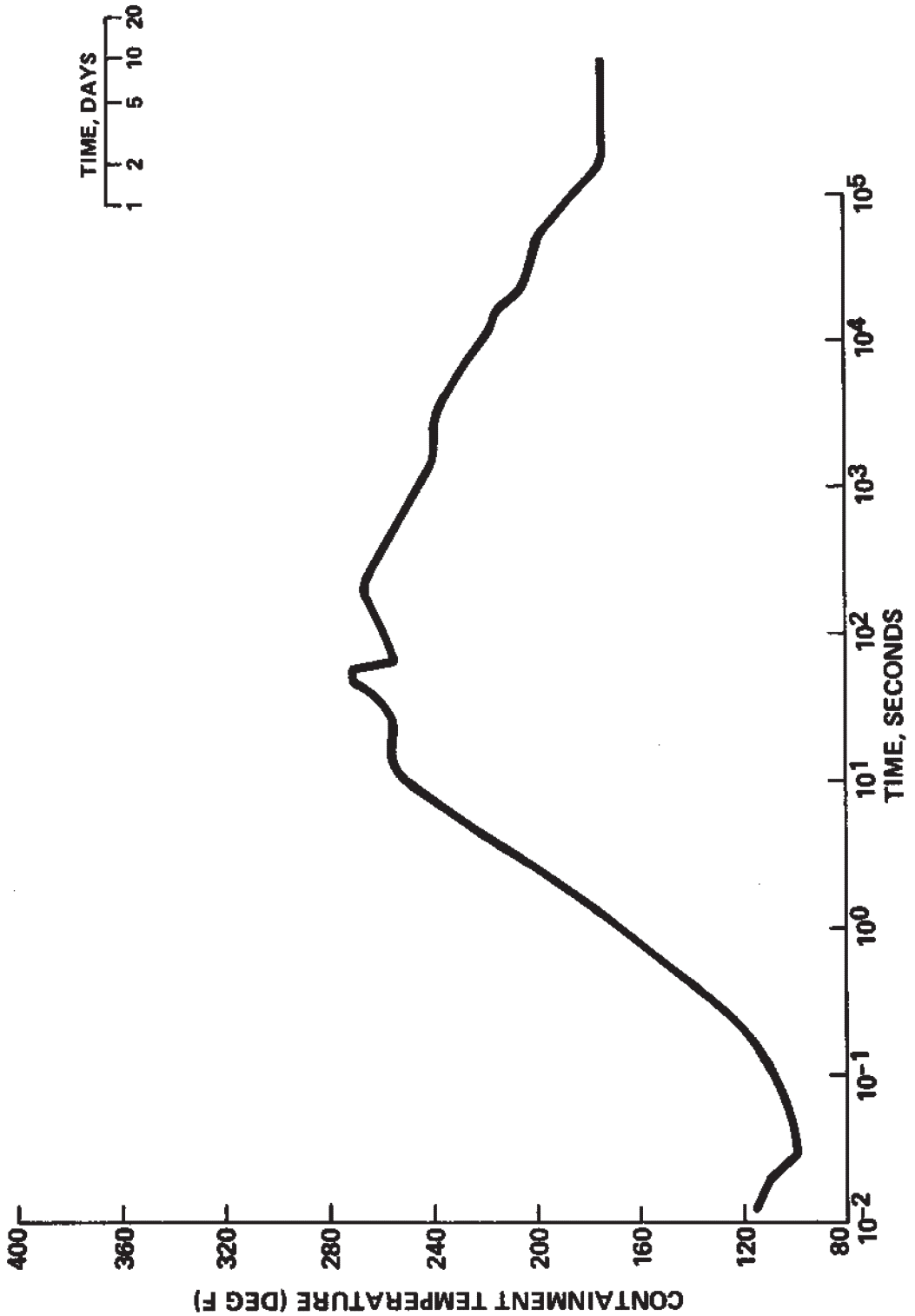
FIGURE 6.2-62



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

CONTAINMENT HYDROGEN RECOMBINER
MODEL B

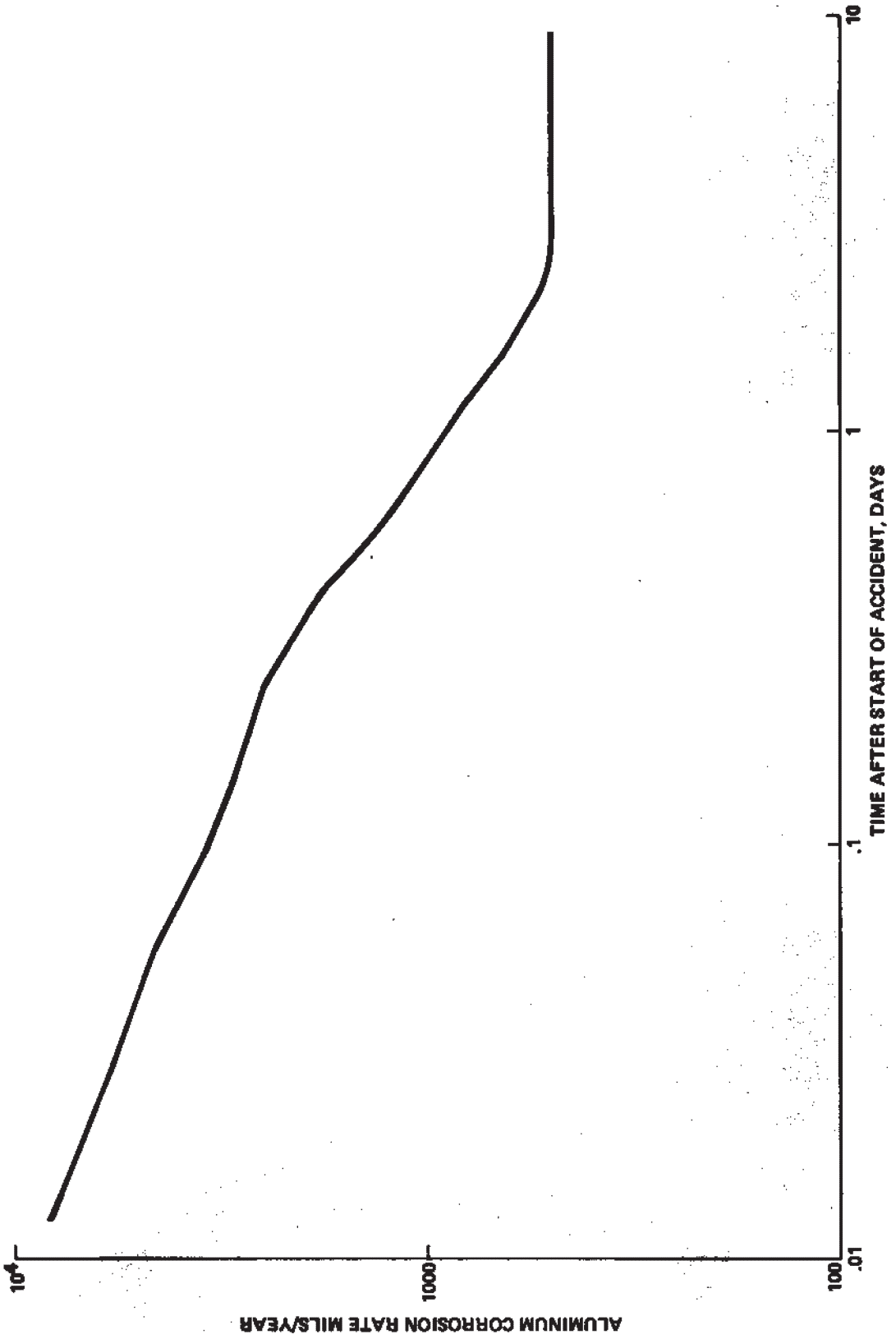
FIGURE 6.2-63



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

LONG TERM CONTAINMENT TEMP. TRANSIENT USED IN POST-LOCA HYDROGEN GENERATION ANALYSIS

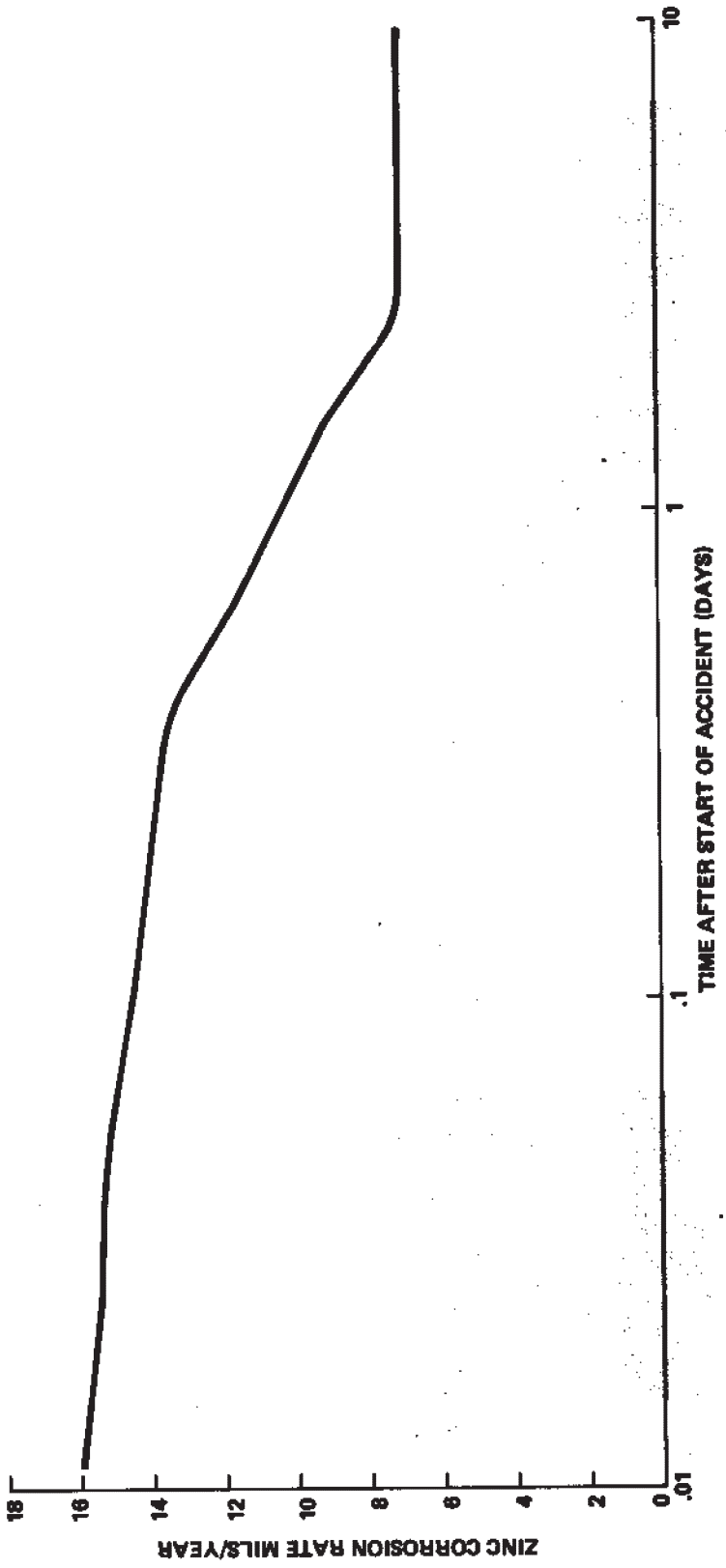
FIGURE 6.2-64



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

ALUMINUM CORROSION RATE AS A FUNCTION OF TIME

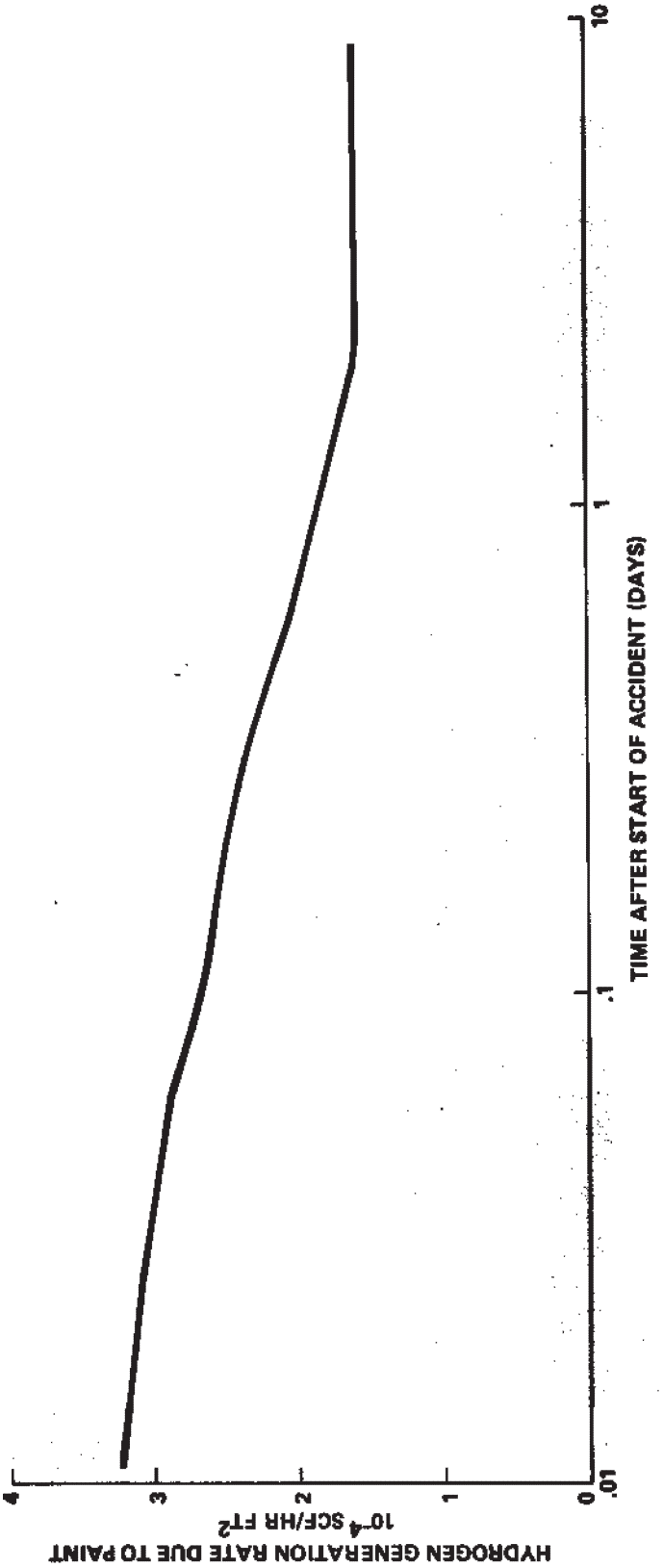
FIGURE 6.2-65



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

ZINC CORROSION RATE AS A FUNCTION OF TIME

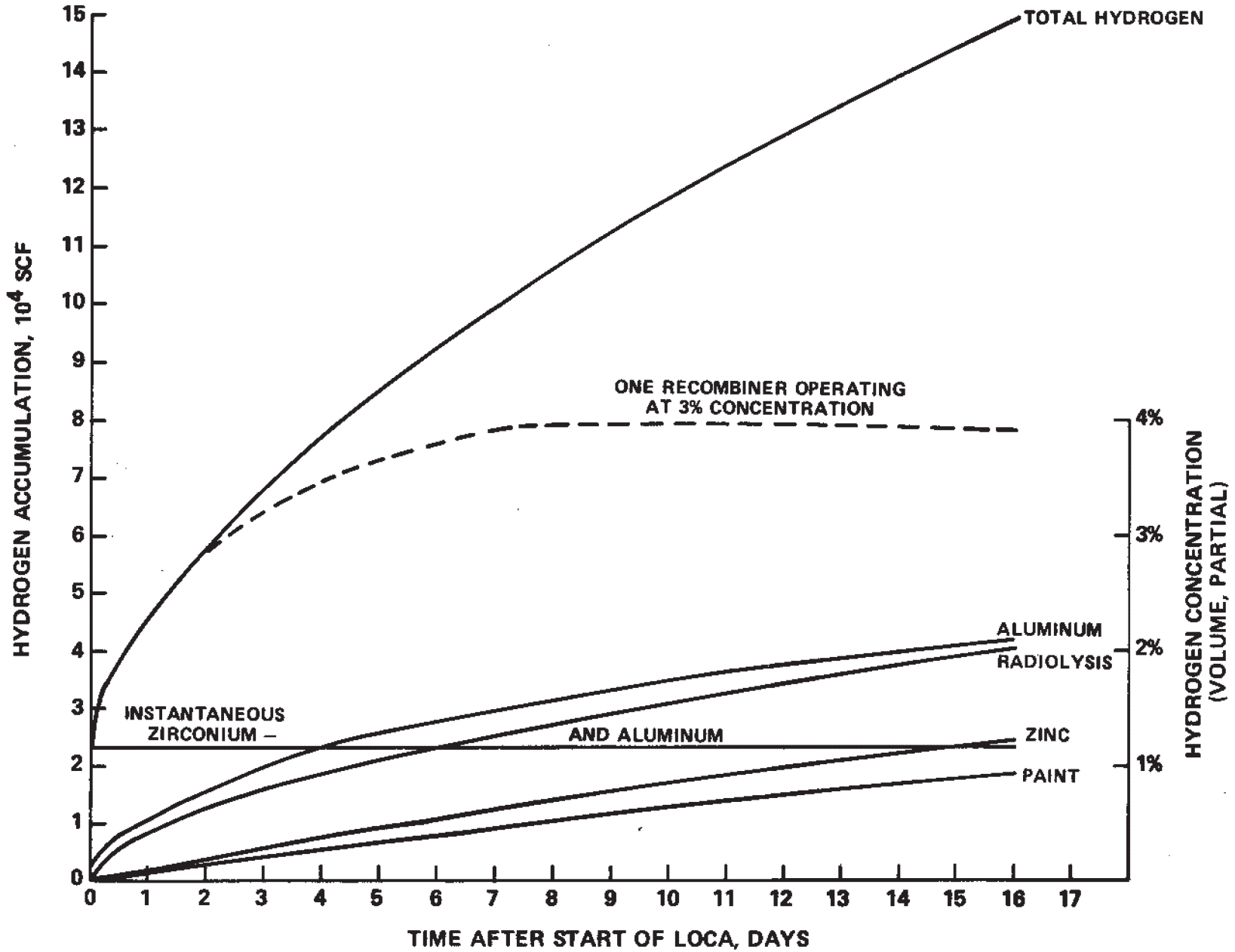
FIGURE 6.2-66



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

HYDROGEN GENERATION RATE DUE TO PAINT AS A FUNCTION OF TIME

FIGURE 6.2-67



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 2

POST LOCA HYDROGEN AS A
FUNCTION OF TIME

FIGURE 6.2-68

APPENDIX 6.2A

The information contained in this section is historical and retained for future reference.

EBASCO MODIFICATIONS TO THE CONTEMPT-LT MOD 26

COMPUTER CODE

The containment pressure and temperature transient analyses are performed with an Ebasco modified version of the CONTEMPT-LT Mod 26 computer code.

In this computer code, the containment volume is divided into two regions, the atmosphere region (water vapor and air mixture) and the sump region (liquid water). Each region is assumed to be completely mixed and in thermal equilibrium. The temperature of each region may be different. Mass and energy additions are made to the appropriate region to simulate the mass and energy release from the Reactor Coolant System or Secondary System during and after blowdown with the contribution of the Safety Injection System (SIS) and Containment Spray System (CSS) water, and decay energy from the core. Account is taken of boiling in the liquid region and condensing in the vapor region, and mass and energy transfers between regions are considered.

The model represents the heat conducting and absorbing materials in the containment by dividing them into segments with appropriate heat transfer coefficients and heat capacities. Thermal behavior is described by the one-dimensional, multi-region, transient heat conduction equation. The heat conducting segments are used to describe materials and surfaces in the containment which act as heat sources or heat sinks. The model includes provision for mathematically simulating cooling of the containment atmosphere by fan coolers and/or by water sprays, and cooling of the SIS sump water being recirculated to the CSS by the shutdown heat exchangers. The CONTEMPT-LT model and formulations have been shown to be applicable and conservative for the design of the containment vessel by simulated design basis accident tests such as the CVTR (see References 2, 3 and 4) blowdown experiment.

Calculations are begun by computing initial steady state containment atmosphere conditions. Subsequent calculations are performed at incremental time steps. Following the pipe rupture, the mass and energy addition to the atmosphere or liquid region is determined for each time interval. Heat losses or gains due to heat-conducting segments are calculated. Then the mass, and energy balance equations are solved to determine containment pressure, temperature of the liquid and vapor region, and heat and mass transfer between regions.

The following modifications have been made to the CONTEMPT-LT code by Ebasco:

a) An option has been added to calculate the condensing heat transfer coefficient between the containment atmosphere and the heat sink surfaces by using formulas based primarily on the work of Tagami (see References 5, 6 or 7). From this work, it was determined that the value of the heat transfer coefficient increases parabolically to peak value at the end of blowdown and then decreases exponentially to a stagnant heat transfer coefficient which is a function of the steam to air weight ratio.

Tagami presents a plot of the maximum value of heat transfer coefficient (h) as a function of "coolant energy transfer speed," which is defined by,

<u>total coolant energy transferred into containment</u>
(containment free volume) X (time interval to peak pressure)

From this the maximum value of h is calculated by:

$$h_{max} = 75 \left(\frac{E}{t_p V} \right)^{0.60}$$

where:

h_{max} = maximum value of h (Btu/hr-ft^2-F)

t_p = time from start of accident to end of blowdown (sec)

V = containment free volume (ft^3)

E = initial coolant energy (Btu)

The parabolic increase of h to its peak value is given by:

$$h = h_{max} \sqrt{\frac{t}{t_p}} \qquad 0 < t < t_p$$

where:

h = heat transfer coefficient between heat sink and air (Btu/hr-ft^2 -F)

t_P = Time period of blowdown

t = time from start of accident (sec)

The exponential decrease of the heat transfer coefficient is given by:

$h = h_{stag} + (h_{max} - h_{stag}) \exp(-0.05 (t-t_p))$ $t > t_p$

where:

h_{stag} = h for stagnant conditions = 2.0 + 50.0 X

and

x = steam to air weight ratio in containment

When the containment atmosphere is saturated or superheated and the heat sink surface is below the saturation temperature, the sink heat flux is calculated using:

$$\dot{q}_t' = h\,A(T_{sat} - T_w)$$

where:

$\dot{q}_t$ = heat flux to sink

A = heat sink surface area

T_{sat} = containment saturation temperature

T_w = heat sink surface temperature

b) When either the Tagami or the Uchida[8] condensing heat transfer coefficient option is specified to calculate heat transfer to heat sink surfaces, certain containment conditions can exist for which condensing heat transfer does not occur. For this situation, the CONTEMPT-LT Mod 26 computer code has been modified to calculate the sink heat transfer using the following free convection correlation[9] :

for $T_v < T_{sat}$ or $T_w > T_{sat}$

$$\dot{q}_t' = h\,A(T_{sat} - T_w)$$

$$h_{fc} = \frac{0.13\,k_f\,(Gr_L\,Pr)_f^{1/3}}{L}$$

$$= 0.13\left(\rho_f^{\,2}\;\; g\,\beta_f\,\Delta T\;\;\; C_{pf}\;\; k_f\;\; 2/\mu_f\right)^{1/3}$$

where:

T_v	=	containment atmosphere temperature
g	=	gravitational constant
β_f	=	$1/T_f$ where T_f equals the absolute temperature of T_v
ΔT	=	$T_v - T_w$
C_{pf}	=	containment atmosphere specific heat at constant pressure
K_f	=	thermal conductivity of containment atmosphere
μ_f	=	containment atmosphere viscosity
H_{fc}	=	free convection heat transfer coefficient
L	=	characteristic length of heat sink surface
ρ_f	=	containment atmosphere density
G_L	=	Greshof number at heat sink surface
Pr	=	Prandlt number of containment atmosphere

c) When either the Tagami or Uchida [8] condensing heat transfer coefficient option is used and it is determined that steam condensation does not occur on the heat sink surfaces, the steam condensation rate is calculated using:

$$\dot{m} = \frac{\dot{q}_t}{h_g - h_{film}}$$

where:

$\dot{m}$ = steam condensation rate

h_g = saturated steam enthalpy at containment steam partial pressure

h_{film} = heat sink condensing film enthalpy

This approach is realistic for the following reasons:

1) When condensation does exist on a heat sink surface, not all energy transfer is due to condensation. The total heat transfer to the sink is actually the sum of a convection and a condensation term.[11] However, the assumption is made when using the Tagami or Uchida heat transfer coefficient options that all heat transfer is due to condensation. Therefore, a conservatively high steam condensation rate is calculated.

2) Since the net condensation at the heat sink liquid condensate film is actually the difference between the simultaneous process of evaporation and condensation[10], saturation conditions exist in the gas at the interface of the containment atmosphere gaseous boundary layer even if the bulk containment atmosphere is superheated. As can be seen in Figure 6.2A-1, a combination of the convective and diffusive effects in the gaseous boundary layer result in a gaseous interface temperature lower than the bulk containment atmosphere temperature. A 100 percent humidity or saturation condition must exist here since evaporation and condensation processes are simultaneously occurring at the gaseous-liquid interface. Since it is a complicated numerical procedure to calculate the gaseous interface temperature, and since the saturated steam enthalpy is not a strong function of pressure between 1 and 70 psia, it is assumed that the saturated steam enthalpy of the bulk atmosphere is equal to the steam enthalpy at the gaseous-liquid interface. This assumption will result in a maximum of eight percent error in the calculated saturated steam enthalpy between 1 and 70 psia.

3) The temperature gradient in the condensate boundary layer is small compared to the gradient in the gaseous boundary layer (Figure 6.2A-1). In fact, the gradient in the condensate liquid boundary is small enough to be assumed negligible. The adequacy of this assumption can be shown by the following calculation. The total heat transfer rate from the bulk containment atmosphere to the heat sink surface is assumed to be calculated using the Tagami or Uchida condensing heat transfer coefficients:

$$\dot{q}_t' = h\,A\,(T_{sat} - T_w)$$

The heat transfer rate in the condensate boundary layer from the gaseous liquid interface to the heat sink wall is primarily due to conduction and can be written as:

$$q_t' = \left(- kA\, I_y \quad \frac{\partial T}{\partial y} \right)_{liquid}$$

where k = thermal conductivity of condensate

therefore:

$$h\,(T_{sat} - T_w) = \left(- k \quad \frac{\partial T}{\partial y} \right)_{liquid}$$

Assuming that the value of k is independent of temperature:

$$q_t' \approx kA \quad \frac{\Delta \; T}{\Delta \; y}$$

Solving for ΔT:

$$\frac{T = h\,(T_{sat} - T_w)\,\Delta y}{k_{liquid}} = \frac{q_t' \quad \Delta y}{A\; k_{liquid}}$$

Using the typically most severe containment conditions resulting from a pipe break analysis which maximize the containment pressure and temperature, it can be shown that the temperature gradient across the condensate film is small and can be neglected. Assuming:

T_{sat}	=	280 F
T_w	=	170 F
A	=	1.0 ft^2
H	=	200 Btu/(hr-ft^2-F)

Then a conservative maximum surface heat flux typical of the results expected following a pipe break accident can be calculated as:

q_t' = 200 (280-170) = 2.2 X 10^4 Btu/hr.

A conservative approximation of the maximum condensate boundary layer thickness can be made assuming the validity of the Nusselt condensation equation for a cool wall in the presence of pure steam[(11), (12)]. The presence of noncondensible gas as air would actually decrease the heat flux and mass condensation rate and consequently decrease the boundary layer thickness. Therefore:

$$\Delta y_{max} = \left[\frac{4\,\mu_f\, k_f\, Z(T_{gi} - T_w)}{g\, h_{fg}\, \rho_f\, (\rho_f - \rho_g)} \right]^{1/4} = 0.0013 \text{ feet}$$

Assuming the following values:

μf (at 200°F) = 0.205 x 10^{-3} lbm/(ft-sec)

k_f (at 200°F) = 0.394 Btu/(hr-ft-F)

Z (conservatively large heat sink height) = 150 feet

T_{gi} (gas-liquid interface temperature) ≈ T_{sat} = 280°F

Note: T_{gi} is actually lower that T_{sat} due to the gas-liquid interface resistance which is large when a noncondensible gas as air is mixed with steam[13]. h_{fg} (represents the actual enthalpy drop from the gas to the liquid)=

1173.8-138.08 = 1035.72

ρ_f(at 200°F) = 1/0.01663 = 60.13 lbm/ft^3

ρ_g(at 280°F) = 1/8.644 = 0.1157 lbm/ft^3

Using an average value for Δy of 0.00065 feet, the value of ΔT becomes 36°F resulting in an average condensate film temperature of about 188°F (conservatively assuming that the temperature gradient in the film is linear). Therefore, the assumption that the condensate film average temperature is 170°F results in a conservative maximum error of about 10 percent at the time of peak heat flux. In reality, the heat sink surface heat flux and temperature gradient across the condensate film is a function of time and normally much less than these assumed maximum conservative values. Thus, the resulting error in the assumption of condensate film temperature is considerably less than 10 percent throughout the major portion of the transient.

d) An option has been added to calculate the heat removal efficiency of the containment sprays when the containment atmosphere is saturated using:

$$e = \frac{h_e - h_n}{h_f - h_n} \approx \frac{T_e - T_n}{T_f - T_n}$$

where:

e	=	spray system efficiency ratio
T_e	=	spray water temperature entering sump region, °F
h_e	=	spray water enthalpy entering sump region
T_n	=	spray water temperature at spray nozzle exit, F
T_f	=	containment vapor region temperature, F
h_f	=	containment vapor region saturated liquid enthalpy
h_n	=	spray water enthalpy at spray nozzle exit

Spray thermal efficiency data are taken from Reference 6. These efficiency data are specified as a function of the steam/air mass ratio in the containment. The data taken from Reference 6 are for a spray system with a mean spray drop diameter of 600 microns. A conservatively short drop fall height of approximately five meters is used. The spray efficiency is shown in Figure 6.2A-2.

The energy removal rate from the containment atmosphere is then computed from the thermal efficiency and energy transfer by

$$\dot{q} = e\dot{m}(h_f - h_n)$$

where:

$\dot{q}$ = spray energy removal rate, Btu/sec

$\dot{m}$ = spray flow rate, lbm/sec

If the containment atmosphere is superheated, the value of h_e can be solved for using the efficiency data and the definition of spray efficiency. Then he and the containment partial steam pressure are used to solve for the final quality (x) of the spray water after interaction with the vapor region. For this case, the energy removal rate is calculated using:

$$\dot{q} = \dot{m}\,(h_f\,(1-x) - h_n)$$

and the mass addition to the containment atmosphere and sump are calculated as:

$$\dot{m}_s = \dot{m}x$$

$$\dot{m}_l = \dot{m}(1-x)$$

where $\dot{m}_s$ = steam addition rate to atmosphere

$\dot{m}_l$ = liquid addition rate to sump region

e) An optional method has been included that determines the steam condensation rate of the containment fan coolers by an interpolation in a table of containment atmosphere saturation temperature versus the fan cooler steam condensation rate.

This additional table is merged with the existing CONTEMPT-LT Mod 26 input of containment atmosphere saturation temperature versus fan cooler heat removal rate.

If the values of fan cooler mass condensation rate input into the fan cooler table are zero, the code will calculate the steam mass condensation rate using the original CONTEMPT-LT Mod 26 assumption.

Following the pipe break inside the containment, the mass and energy of the containment atmosphere, and the mass of the containment sump are updated using the rates interpolated from the input table. Additionally, consistant with the assumptions of the CONTEMPT-LT Mod 26 code, the temperature of the fan cooler condensate is conservatively assumed to be at the containment atmosphere saturation temperature.

Therefore, the condensate energy addition rate to the containment sump is calculated by:

$$\dot{q}_{sump} = \dot{m}_{condensate}\, h_r$$

Where:

$\dot{q}_{sump}$	=	steam condensate energy addition rate to the sump region
$\dot{m}_{condensate}$	=	fan cooler steam condensation rate obtained from the table interpolation or calculated using the CONTEMPT-LT Mod 26 methods
h_r	=	saturated liquid enthalpy of containment atmosphere 6.2A-8

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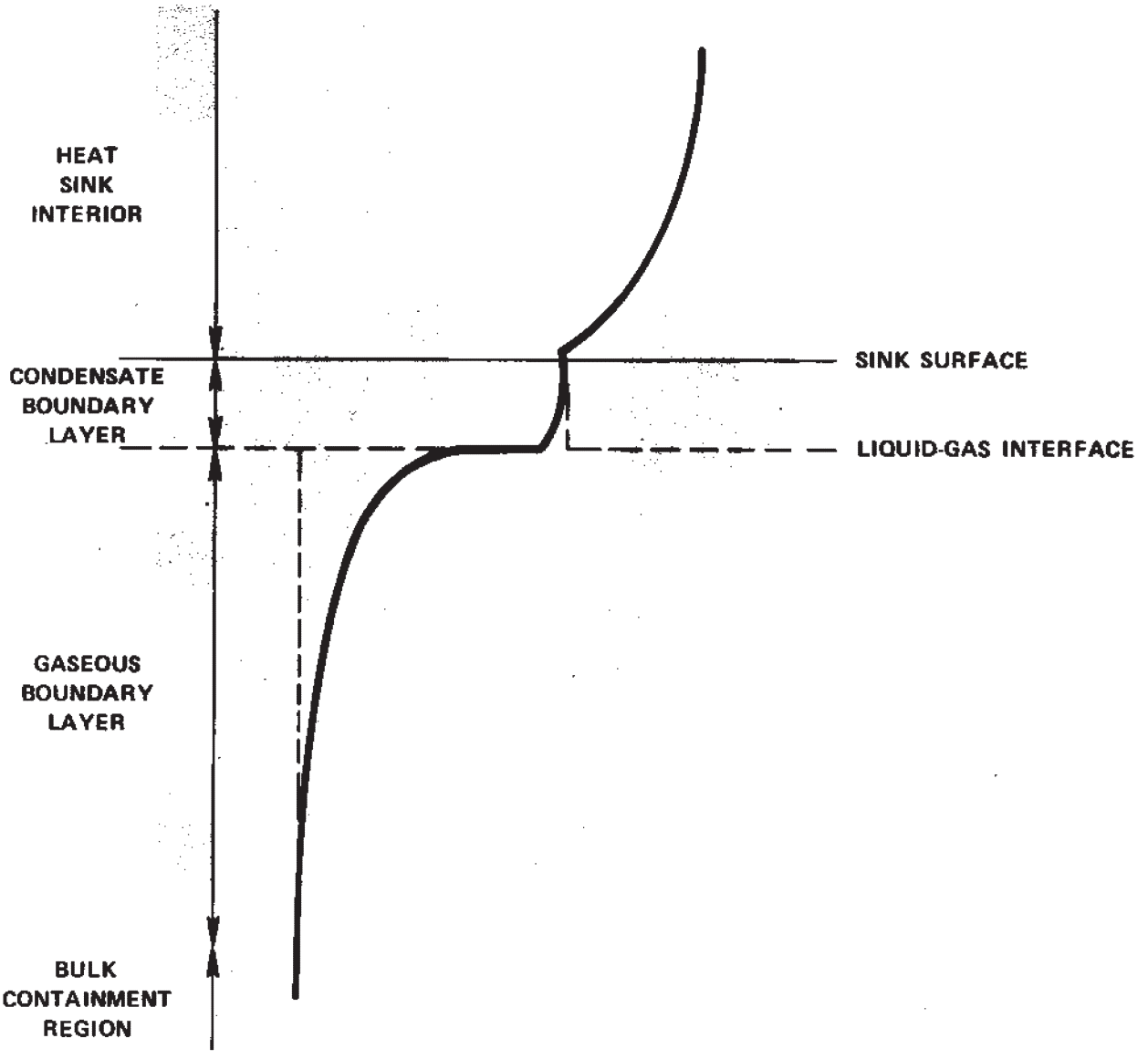

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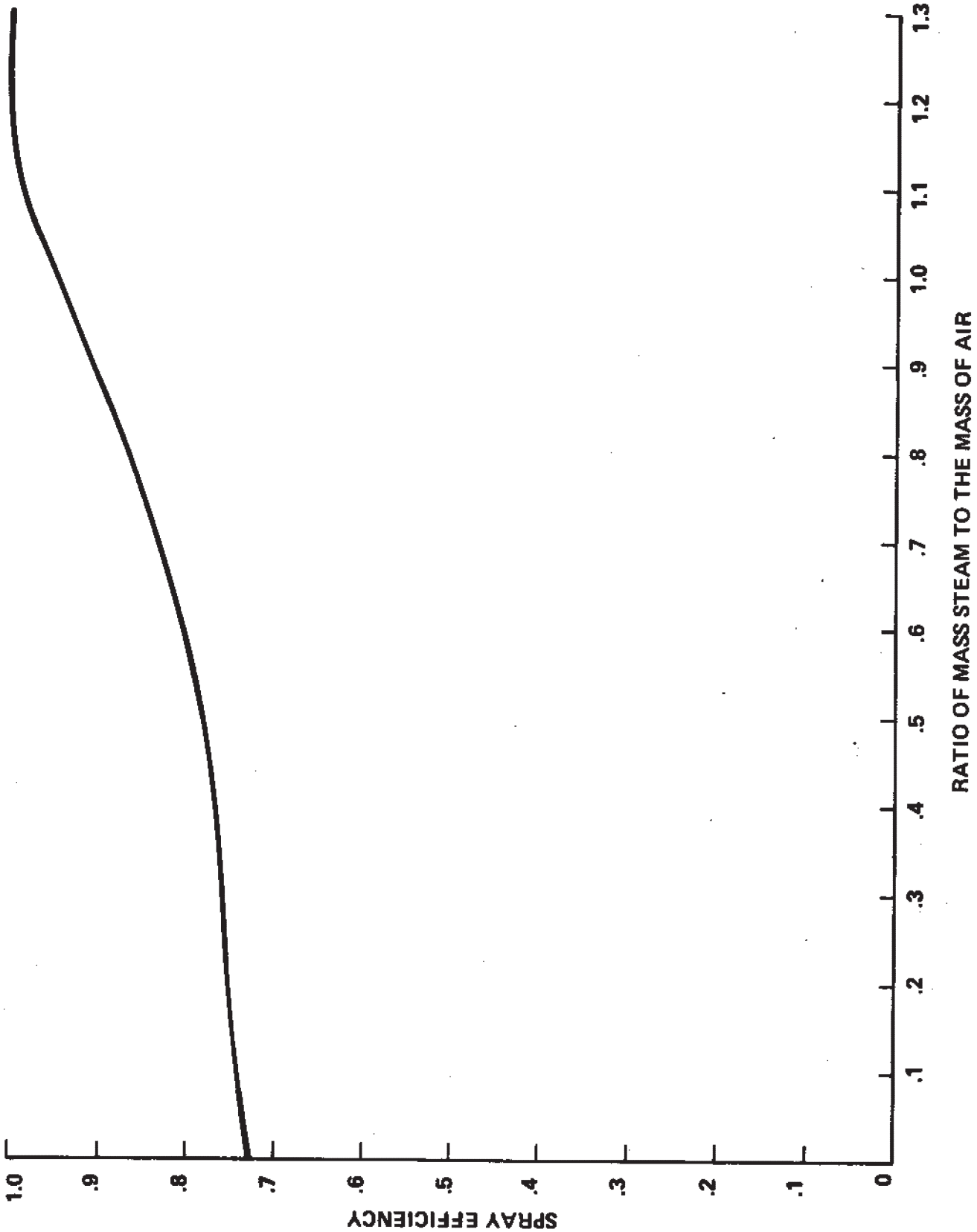
ST. LUCIE PLANT UNIT 2

TEMPERATURE GRADIENT IN GASEOUS & LIQUID BOUNDARY LAYERS DURING HEAT SINK SURFACE CONDENSATION

FIGURE 6.2A-1



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SPRAY EFFICIENCY VS STEAM/AIR RATIO

FIGURE 6.2A-2

APPENDIX 6.2B

(Historical)

WATEMPT - A COMPUTER CODE TO CALCULATE THE SHIELD BUILDING ANNULUS TRANSIENT

Introduction

Many pressurized water reactor (PWR) containment buildings have a multibarrier dry containment system. This consists of a free standing steel containment vessel surrounded by an annular gas space several feet thick (annulus) and a concrete Shield Building. A loss-of-coolant accident (LOCA) causes a pressure buildup in the annulus as a result of containment vessel expansion and heat and mass flow into the Shield Building annulus atmosphere across the primary containment vessel. To limit the pressure rise and to maintain the annulus at a negative gage pressure following the postulated accident, a Shield Building Ventilation System (SBVS) exhausts filtered annulus gas. The WATEMPT computer code determines exhaust rates and sizes the SBVS equipment to maintain a negative annulus pressure following a LOCA inside the primary containment.

The WATEMPT code is primarily an extension of the CONTEMPT[1] code. It uses slightly modified CONTEMPT type calculations to determine the containment and annulus, pressure and temperature, initial and transient conditions, and the distribution of heat across the steel containment structure and concrete Shield Building wall.

In the WATEMPT computer code, the containment and the annulus volumes are divided into two regions, the atmospheric region (water vapor and air mixture) and the liquid region. Each individual region is assumed to be completely mixed and in thermal equilibrium. The temperature of the two regions may be different. Mass and energy additions are made to the appropriate region to simulate the various leakage and heat transfer processes. Account is taken of condensation in the vapor region and mass and energy transfers between regions.

The code represents the heat conducting and absorbing materials in the containment by dividing them into segments with appropriate heat transfer coefficients and heat capacities. The steel containment vessel and the concrete Shield Building are the only heat sinks in contact with the Shield Building atmosphere.

Initial temperature distributions in the heat conducting regions are computed from the steady heat conduction equation and the boundary temperatures specified in the input. The containment vessel is represented by several heat conducting sections whose transient thermal behavior can be described by the one-dimensional multi-region transient heat conduction equation. Heat is transferred from the containment vapor region into the annulus atmosphere through these sections. Any additional energy added to the annulus atmosphere from such sources as annulus equipment operation can be inputed by a tabular representation of annulus energy input rates as a function of time.

Following the postulated LOCA, the annulus conditions are calculated to determine the time required to start the Shield Building Ventilation System fans in order to prevent the Shield Building annulus pressure from exceeding atmospheric pressure. The conditions at any time for both the containment and annulus are determined by calculating mass and energy gains and

losses during a specified time step. The pressures and temperatures are then calculated in each region based on the mass, volume, and energy balance equations. All of these equations are set up and solved exactly as in the original CONTEMPT code. The convective heat transfer coefficient between the walls of the annulus and the annulus atmosphere is based upon formulas given in References 2 and 3 for natural convection from relatively flat plates in air at large Grashof numbers. Appropriate factors have been used in the formulas to account for the increased surface area of a concrete surface in comparison to a smooth steel surface and for the actual configuration of the steel dome and the top of the concrete Shield Building. Thermal radiation between concentric or nearly concentric walls is described by the usual gray body radiation heat transfer equations. Radiation heating of the concrete Shield Building from the steel shell is considered in the analysis. Direct radiation heat absorption by the annulus atmosphere is neglected; however, heating of the annulus atmosphere by conduction and convection is considered. The average annulus atmosphere temperature is used in all calculations. The assumed emissivity values are the highest values expected for steel and concrete. The effect of radiant heat transfer is to heat the concrete Shield Building by radiation from the hot steel containment. This results in net convective heat addition to the annulus atmosphere from the concrete Shield Building.

Leakage into and out of the annulus is calculated based on pressure dependent leakage rate formulas. The dependency of the annulus and containment volumes on the containment wall temperature and the differential pressure across the containment vessel is considered at all times. The Shield Building Ventilation System is represented by input tables describing fan size, system resistance, and pressure dependent flow characteristics.

Transient calculations in the WATEMPT computer code are performed by evaluating tabular input rates at the midpoint of a time interval, multiplying by the time interval, and adding increments to current amounts in either the containment or annulus. Heat losses or gains to the heat conducting sections are estimated by extrapolating heat transfer rates (including radiant heat transfer) of the previous two time steps (or the steady state conditions for the initial time steps) to the midpoint of the current time interval.

Similar extrapolations are performed for leakage rates into or out of the annulus, including SBVS exhaust rates, and for the containment and annulus volume and energy change resulting from pressure and temperature expansion of the steel containment vessel. The pressure and temperature of the annulus are then calculated. The new annulus conditions are used to obtain heat transfer, leakage and volume change rates at the end of the time step. These are averaged with corresponding values from the beginning of the time step to calculate the current annulus conditions. Annulus pressure and temperature are then recalculated, and the end of the time step annulus conditions are used as the initial condition for the next time step.

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