The Light company Houston Lighting & Power P.O. Box 1700 Houston, Texas 77001 (713) 228-9211

August 20, 1984
ST-HL-AE-1115
File No: G9.10/C11.1/N3.8.4.1/
N3.8.10

Mr. Harold R. Denton
Director, Office of Nuclear
Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Denton:

South Texas Project
Units 1 & 2
Docket Nos. STN 50-498, STN 50-499
Elimination of Arbitrary Intermediate Pipe Breaks

Houston Lighting and Power Co. (HL&P) has followed closely the recent activities of the Nuclear Regulatory Commission (NRC) staff and the nuclear industry related to the treatment of design basis pipe breaks in high energy piping systems. Modification of the current NRC requirements for postulating break locations to eliminate from design consideration those intermediate break locations generally referred to as arbitrary intermediate breaks offers considerable benefits since pipe whip restraints, jet shields and other provisions currently incorporated in plant designs to mitigate the effects of these postulated breaks would no longer be required.

NRC currently requires that pipe breaks be postulated at terminal ends and at intermediate locations where stresses or cumulative usage factors exceed specified limits. If two intermediate locations cannot be determined based on the above criteria, i.e., stresses and cumulative usage factors are below specified limits, breaks must be arbitrarily postulated at the two highest intermediate stress locations.

HL&P believes that current knowledge and experience supports our conclusion that designing for the arbitrary intermediate breaks is not technically justified and that this requirement should be deleted. Arbitrary intermediate breaks are often postulated at locations where stresses are well below the ASME Code allowables and within a few percent of the stress levels at other points in the same system. This results in complicated protective features being provided for specific break locations in the piping system that provide little to enhance overall plant safety.

HL&P, therefore, requests NRC approval of the application of the following alternative pipe break criteria (excluding the RCS primary loop) for the South Texas Project.

8408270355 840820
PDR ADOCK 05000498
A PDR

W2/NRC2/s

B001
1/1

- Piping systems will be designed to accommodate pipe breaks at terminal ends and at locations where a) the stress criterion of Branch Technical Position (BTP) MEB 3-1 is exceeded, or b) for Class 1 piping only, where the usage factor criterion of BTP MEB 3-1 is exceeded. No arbitrary intermediate breaks will be postulated where the above stress or usage factor criteria are not exceeded.

- The dynamic effects (pipe whip, jet impingement and compartment pressurization loads) associated with previously postulated arbitrary intermediate pipe breaks will be excluded from the plant design basis.

- Pipe whip restraints and jet shields associated with previously postulated arbitrary intermediate pipe breaks will be eliminated.

- Application of the above criteria will not affect environmental qualification (EQ) of equipment. Breaks will continue to be postulated non-mechanistically at the previous arbitrary intermediate break locations for EQ purposes.

In support of this request HL&P is providing the following additional information:

- Attachment A provides the technical justification for the revised criteria supporting the elimination of the need to consider arbitrary intermediate breaks.

- Attachment B provides a summary of arbitrary intermediate breaks to be eliminated. Piping and system design is an iterative process and postulated break locations may change as the system design and pipe stress analyses are finalized. In view of anticipated changes in pipe break design, HL&P proposes to eliminate the arbitrary intermediate breaks currently identified in Attachment B as well as the need to postulate new arbitrary intermediate break locations, in the systems identified therein, during the ongoing design process.

- Attachment C describes provisions in the STP design which minimize stress corrosion cracking in high energy lines.

- Attachment D describes provisions for minimizing the effects of thermal and vibration induced piping fatigue.

- Attachment E describes provisions in the STP design which minimize steam/water hammer effects.

- Attachment F describes benefits which will be derived from elimination of the need to postulate the arbitrary breaks listed in Attachment B.

In order to achieve the maximum benefit in terms of reduced occupational radiation exposure and improved operation and maintenance access, as well as to avoid as much of the design, purchase and installation costs as possible, we look forward to expeditious action on this request. If you should have any questions regarding this matter, please contact Mr. Michael E. Powell at (713) 993-1328.

Very truly yours,

J.H. Goldberg

J. H. Goldberg
Vice President
Nuclear Engineering and Construction

LJK/mg

Attachment A	Technical Justification for Elimination of Arbitrary Intermediate Breaks
Attachment B	Arbitrary Intermediate Break Location Summary
Attachment C	Provisions for Minimizing Stress Corrosion Cracking in High Energy Lines
Attachment D	Provisions for Minimizing the Effects of Thermal and Vibration Induced Piping Fatigue
Attachment E	Provisions for Minimizing Water/Steam Hammer Effects
Attachment F	Benefits Resulting from the Elimination of Arbitrary Intermediate Breaks

W2/NRC2/s

cc:

Darrell G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

John T. Collins
Regional Administrator, Region IV
Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 1000
Arlington, TX 76012

Victor Nerses, Project Manager
U.S. Nuclear Regulatory Commission
7920 Norfolk Avenue
Bethesda, MD 20016

D. P. Tomlinson
Resident Inspector/South Texas Project
c/o U.S. Nuclear Regulatory Commission
P. O. Box 910
Bay City, TX 77414

M. D. Schwarz, Jr., Esquire
Baker & Botts
One Shell Plaza
Houston, TX 77002

J. R. Newman, Esquire
Newman & Holtzinger, P.C.
1025 Connecticut Avenue, N.W.
Washington, DC 20036

Director, Office of Inspection
and Enforcement
U.S. Nuclear Regulatory Commission
Washington, DC 20555

E. R. Brooks/R. L. Range
Central Power & Light Company
P. O. Box 2121
Corpus Christi, TX 78403

H. L. Peterson/G. Pokorny
City of Austin
P. O. Box 1088
Austin, TX 78767

J. B. Poston/A. vonRosenberg
City Public Service Board
P. O. Box 1771
San Antonio, TX 78296

Brian E. Berwick, Esquire
Assistant Attorney General for
the State of Texas
P. O. Box 12548, Capitol Station
Austin, TX 78711

Lanny Sinkin
Citizens Concerned About Nuclear Power
114 W. 7th, Suite 220
Austin, TX 78701

Robert G. Perlis, Esquire
Hearing Attorney
Office of the Executive Legal Director
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Charles Bechhoefer, Esquire
Chairman, Atomic Safety & Licensing Board
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dr. James C. Lamb, III
313 Woodhaven Road
Chapel Hill, NC 27514

Judge Ernest E. Hill
Hill Associates
210 Montego Drive
Danville, CA 94526

William S. Jordan, III, Esquire
Harmon & Weiss
1725 I Street, N.W.
Suite 506
Washington, DC 20006

Citizens for Equitable Utilities, Inc.
c/o Ms. Peggy Buchorn
Route 1, Box 1684
Brazoria, Texas 77422

Revised 07/31/84

W2/NRC2/s

TECHNICAL JUSTIFICATION FOR ELIMINATION OF ARBITRARY INTERMEDIATE BREAKS

The following items provide technical justification for the elimination of arbitrary intermediate pipe breaks and the associated pipe whip restraints.

1. Pipe rupture is recognized in Branch Technical Position MEB 3-1 as being a "rare event which may only occur under unanticipated conditions."

2. Pipe breaks are postulated to occur at locations where stresses exceed 80% of ASME Code allowables or where the cumulative usage factor exceeds 10% of the Code allowable (Class 1 piping). Where no breaks exceed these criteria, two arbitrary breaks per stress analysis have been postulated. Therefore, the arbitrary break locations all exhibit stresses and usage factors below these conservative thresholds.

3. Operating procedures and piping and system designs are prepared to minimize the possibility of stress corrosion cracking, thermal and vibration induced fatigue and water/steam hammer in lines where arbitrary pipe breaks are currently postulated. Detailed descriptions of the design provisions for these phenomena are provided in attachments C, D and E respectively.

4. Arbitrary intermediate breaks are only postulated to provide additional conservatism in the design. There is no technical justification for postulating these breaks.

5. Generally, welded attachments are not located in close proximity to the arbitrary intermediate breaks. Arbitrary intermediate break locations located in proximity to welded piping attachments, other than shear lugs, will not be eliminated. Consequently, there are no local bending stresses resulting from these attachments which could affect the stress levels at the break locations being deleted.

6. The pipe whip restraints necessary for pipe breaks which are not being eliminated provide an adequate level of protection.

7. Elimination of pipe whip restraints associated with the arbitrary breaks will facilitate in-service inspection, reduce heat losses from the restrained piping, and prevent the introduction of stress from the unintended restraint of piping due to thermal growth and seismic motion. (See "Effects of Postulated Event Devices on Normal Operation of Piping Systems in Nuclear Power Plants," NUREG/CR-2136, Teledyne Services, 1981.)

8. Pipe break related equipment qualification (EQ) requirements will not be affected by the elimination of the arbitrary breaks. Breaks will continue to be postulated non-mechanistically for EQ purposes.

It is concluded that the elimination of arbitrary intermediate breaks is technically justified, based on the reasons stated above.

W2/NRC2/s

ARBITRARY INTERMEDIATE BREAKS
INSIDE CONTAINMENT

Problem No.	Description	Line Designation	Breaks (1) Eliminated	Restraints (2) Eliminated
Residual Heat Removal/Safety Injection System				
RHR/ SI-01	Hot Leg Loop #1 to RHR Pump A Suction	12"-RC-1112-BB1	4	3
RHR/ SI-05	RC Loop 1 Hot Leg to the Intermediate Anchor on 8" RH-1110 and to line No. 6"-SI-1107-BB2 (RHR/SI-03)	8"-RC-1114-BB1 8"-SI-1108-BB1 6"-SI-1108-BB1	1 1 1	0 0 0
RHR/ SI-09	Hot Leg Loop #2 to RHR Pump B Suction	12"-RC-1212-BB1	4	0
RHR/ SI-13	RC Loop 2 Hot Leg to the Intermediate Anchor on 8"-RH-1210	8"-RC-1214-BB1 8"-SI-1208-BB1 6"-SI-1208-BB1	2 1 1	0 0 0
RHR/ SI-16	Hot Leg Loop #3 to RHR Pump C Suction	12"-RC-1312-BB1	4	3
RHR/ SI-20	RC Loop 3 Hot Leg to the Intermediate Anchor on 8" RH-1309-KB2	8"-RC-1324-BB1 8"-SI-1327-BB1	1 2	0 0

Notes

1. These numbers are approximate.
2. These quantities are subject to change since pipe break evaluation is not complete. They represent a conservatively low estimate of the anticipated quantities.
3. To be determined.

ARBITRARY INTERMEDIATE BREAKS INSIDE CONTAINMENT

Problem No.	Description	Line Designation	Breaks (1) Eliminated	Restraints (2) Eliminated
<u>Auxiliary Feedwater System</u>				
AF-1	Auxiliary Feedwater from Steam Generator 1A to Containment Penetration M-94	8"-AF-1008-GA2	2	3
AF-2	Auxiliary Feedwater from Steam Generator 1B to Containment Penetration M-95	8"-AF-1010-GA2	4	4
AF-3	Auxiliary Feedwater from Steam Generator 1C to Containment Penetration M-84	8"-AF-1012-GA2	4	6
AF-4	Auxiliary Feedwater from Steam Generator 1D to Containment Penetration M-83	8"-AF-1006-GA2	4	7
<u>Feedwater System</u>				
FW-01	From Steam Generator 101 to Containment Penetration M-6	18"-FW-1012-GA2	2	1
FW-02	From Steam Generator 102 to Containment Penetration M-7	18"-FW-1014-GA2	2	1

ARBITRARY INTERMEDIATE BREAKS
INSIDE CONTAINMENT

Problem No.	Description	Line Designation	Breaks (1) Eliminated	Restraints (2) Eliminated
FW-03	From Steam Generator 103 to Containment Penetration M-8	18"-FW-1016-GA2	4	1
FW-04	From Steam Generator 104 to Containment Penetration M-5	18"-FW-1018-GA2	4	1
Chemical and Volume Control System				
CV-02/ CV-03	CVCS Letdown Line from Regenerative Heat Exchanger to Containment 2"-CV-1003-BB2	3"-CV-1006-KB2 4"-CV-1010-KB2	1 1	0 0
CV-04	CVCS Charging Line Containment Penetration M-48 to Regenerative Heat Exchanger (tube inlet)	4"-CV-1116-BB2	2	2
Steam Generator Blowdown System				
SB-01	SG Blowdown Line from Steam Generator 101 to Penetration M-63	4"-SB-1101-JA2 2"-SB-1101-JA2 2"-SB-1103-JA2	4	(3)
SB-02	SB Blowdown Line from Steam Generator 102 to Penetration M-64	4"-SB-1201-JA2 2"-SB-1201-JA2 2"-SB-1203-JA2	4	(3)
SB-03	SG Blowdown Line from Steam Generator 103 to Penetration M-65	4"-SB-1301-JA2 2"-SB-1301-JA2 2"-SB-1303-JA2	4	(3)

ARBITRARY INTERMEDIATE BREAKS
INSIDE CONTAINMENT

Problem No.	Description	Line Designation	Breaks (1) Eliminated	Restraints (2) Eliminated
SB-04	SG Blowdown Line from Steam Generator 104 to Penetration M-62	4"-SB-1401-JA2 2"-SB-1401-JA2 2"-SB-1403-JA2	4	(3)
<u>Reactor Coolant System</u>				
RC-02	Pressurizer Spray Line		(3)	(3)
RC-04	RTD Piping		(3)	(3)
RC-05	RTD Piping		(3)	(3)
RC-06	RTD Piping		(3)	(3)
RC-07	RTD Piping		(3)	(3)
RC-19	Loop 1 to Reactor Coolant Drain Tank	2"-RC-1121-BB1	2	0
RC-20	Loop 2 to Reactor Coolant Drain Tank	2"-RC-1220-BB1	2	0
<u>Main Steam</u>				
MS-01	From Steam Generator 101 to Penetration M-2	30"-MS-1001-GA2	4	4
MS-02	From Steam Generator 102 to Penetration M-3	30"-MS-1002-GA2	4	4
MS-03	From Steam Generator 103 to Penetration M-4	30"-MS-1003-GA2	4	3

ARBITRARY INTERMEDIATE BREAKS INSIDE CONTAINMENT

Problem No.	Description	Line Designation	Breaks (1) Eliminated	Restraints (2) Eliminated
MS-04	From Steam Generator 104 to Penetration M-1	30"-MS-1004-GA2	4	3
Total Breaks Identified To Date			88	46

Arbitrary Intermediate Breaks Outside Containment

System	Number (1) of Breaks	Number (2) of Restraints
Main Steam System	32	-
Main Feedwater System	32	-
Auxiliary Feedwater System	32	-
Steam Generator Blowdown	20	-
Chemical and Volume Control System	12	-
Auxiliary Steam	4	-
Total	132	-

(1) These numbers are approximate.
(2) These numbers are not available.

Attachment C
ST-HL-AE-1115
File Number: G9.10
Page 1 of 2

PROVISIONS FOR MINIMIZING STRESS CORROSION CRACKING IN HIGH ENERGY LINES

Industry experience (NUREG 0691) has shown that there is a strong potential for stress corrosion cracking (SCC) if the following three conditions exist simultaneously: (1) high tensile stresses, (2) susceptible piping material, and (3) a corrosive environment. Although any stainless or carbon steel piping will exhibit some degree of residual stresses and material susceptibility, Houston Lighting and Power Company minimizes the potential for SCC by choosing piping material with low susceptibility to stress corrosion and by preventing the existence of a corrosive environment. The material specifications consider compatibility with the system's operating environment (both internal and external), other materials present in the system, applicable ASME code requirements, fracture toughness characteristics, welding procedures, and pipe fabrication techniques.

The likelihood of stress corrosion cracking in stainless steel increases with carbon content. Consequently, only the lower carbon content stainless steels (304, 304L, 316, 316L) have been used in high energy systems in contact with the reactor coolant system (RCS)(1). The existence of a corrosive environment is prevented by strict criteria for internal and external pipe cleaning, and water chemistry control during preoperation testing and normal plant operation. The maintenance of extremely low residual oxygen concentrations (less than 0.005 ppm) within the RCS and systems in direct contact with the RCS during normal operation, precludes the occurrence of pipe cracking which has been identified at some facilities.

For most secondary systems,(2) ferritic type carbon steel is used for piping, fittings, and valve bodies forming the pressure boundaries. Significant portions of the Steam Generator Blowdown System (SGBDS) (steam generator to flash tank) use ferritic alloy steel. This ferritic material has been found satisfactory from the standpoint of non-susceptibility to stress corrosion cracking for the service conditions encountered.

---

(1) High Energy Systems in Contact with the RCS:
Chemical and Volume Control (CVCS)
Safety Injection (SI)

(2) Secondary Systems:
Main Steam (MS)
Main Feedwater (MFW)
Auxiliary Feedwater (AFW) (discharge piping from the pumps to each steam generator is carbon steel. Stainless steel is used in portions of the system that is not normally under significant pressure, i.e., suction and crossover piping.)
Steam Generator Blowdown (SGBDS)
Auxiliary Steam (AS)

High energy piping systems are cleaned externally and flushed as part of the preoperational test program. The piping is flushed with demineralized water subject to limits on total dissolved solids, conductivity, chlorides, fluorides and pH. Flush water quality is monitored daily. The flushing is controlled in accordance with procedures. Water chemistry for preoperational testing is controlled by written specifications.

During plant operation, primary and secondary side water chemistry are monitored. Contaminant concentrations are maintained below the thresholds known to be conducive to stress corrosion cracking. The water chemistry control standards are included in operating procedures for the systems where arbitrary breaks are being eliminated.

Attachment B identifies the systems where postulated arbitrary intermediate breaks are being eliminated. Portions of these systems operate at temperatures below 200°F. Industry experience shows that stress corrosion is not a significant concern at temperatures this low. The water chemistry requirements for primary systems are presented in FSAP section 5.2.3. Secondary system water chemistry control is discussed in FSAR section 10.3.5.

W2/NRC2/s

PROVISIONS FOR MINIMIZING THE EFFECTS OF THERMAL AND VIBRATION INDUCED PIPING FATIGUE

I. GENERAL FATIGUE DESIGN CONSIDERATIONS

Fatigue considerations are addressed in STP Class 1 piping by the use of a cumulative usage factor (CUF). In order to ensure that piping does not fail due to fatigue, the ASME Code limits the CUF to a maximum of 1.0. Arbitrary intermediate break locations are limited to a CUF below 0.1. This provides assurance that fatigue will not be a concern at these locations.

For Class 2 and 3 lines, fatigue is considered in the ASME Code allowable stress range check for thermal expansion stresses. This stress is included in the total stress value used to determine postulated break locations. All arbitrary break locations are limited to stresses less than 80% of the code allowables. If the number of thermal cycles is expected to be greater than 7,000, then the allowable stresses are further reduced by an amount dependent on the number of cycles.

An appropriately conservative condition exists as a result of postulating break locations which exceed the CUF (Class 1) and stress limitations above. Postulation of additional arbitrary intermediate breaks with CUF and stress valves within these limits does not significantly add to the protection against fatigue failure.

II. THERMAL DESIGN CONSIDERATIONS

The STP steam generators have separate nozzles for auxiliary feedwater (upper nozzle) and main feedwater (lower nozzle). Thermal fatigue is minimized in the main feedwater piping by preventing the introduction of cold water. The main feedwater lines inside the RCB are used only when feedwater temperatures downstream of the containment isolation valves are above 250°F. This is assured by permissives on the feedwater isolation valves which prevent their opening until the downstream feedwater temperatures measured at two locations are above 250°F. Feedwater temperature is maintained above 250°F by heating in the deaerator with extraction, main, or auxiliary steam. During shutdown, startup, and hot standby water is provided to the upper steam generator nozzle. The upper nozzle to the steam generator uses a thermal sleeve to minimize pipe stress resulting from thermal considerations.

Although the arbitrary intermediate break locations in the main and auxiliary feedwater systems are being eliminated, the terminal end break locations at the steam generator nozzles are unaffected. The heat affected zone adjacent to the main feedwater nozzles is the region which has experienced pipe cracks in PWRs. STP is designed to mitigate the consequences of a circumferential pipe break at these locations and bring the plant to a safe shutdown condition.

III. VIBRATION DESIGN CONSIDERATIONS

Piping is designed and supported to minimize transient and steady state vibration. Piping system vibration testing will be performed as described in FSAR Section 3.9.2 to ensure that piping system vibration is within allowable levels.

PROVISIONS FOR MINIMIZING STEAM/WATER HAMMER EFFECTS

The reactor coolant, safety injection, chemical and volume control, and residual heat removal systems have been designed to preclude water hammer. Westinghouse has conducted a number of investigations into the causes and consequences of water hammer events. The results of these investigations have been reflected in STP design interface requirements to assure that water hammer events initiated in the BOP secondary systems do not compromise the performance of the Westinghouse supplied safety-related systems and components.

The lines in which arbitrary intermediate breaks are being eliminated and which have the potential for water/steam hammer effects are being designed to minimize or preclude such effects. Water hammer protection in each of these systems is described below:

1. Safety Injection System

   The safety injection lines are all water solid at ambient temperature, thus no water hammer is expected.

2. Chemical and Volume Control System (CVCS)

   Normally, the CVCS is water solid. In the low temperature lines (less than 125°F) water hammer would not be expected because of the small probability of steam void formation. In the high temperature lines, the piping has been designed to maintain water solid conditions during normal operation, thus minimizing the possibility of water hammer effects.

3. Reactor Coolant System

   Water hammer is not expected to be a concern in the reactor coolant system, because it is designed to preclude steam void formation.

4. Residual Heat Removal (RHR) System

   The RHR system lines are all water solid, thus no water hammer is expected.

5. Auxiliary Feedwater System

   A separate auxiliary feedwater line and nozzle has been provided to each steam generator to minimize the potential for water hammer. This is in addition to the following design measures. The auxiliary feedwater discharge pipe inside the steam generator is arranged to prevent water draining from the pipe following a drop in steam generator water level. Piping volume connected to the steam generator nozzle which could form a steam void is minimized by minimizing the length of horizontal inlet piping.

6. Steam Generator Blowdown System

Blowdown flow from the steam generators is normally two-phase and of 0-7 percent quality. The normal flow regime between the steam generator and the blowdown control valve is slug flow. This section of pipe is run in horizontal and descending vertical legs to the piping low point drain located at the blowdown control valve. The normal flow regime downstream of the blowdown control valve to the flash tank lies in the dispersed flow regime. Operating procedures calling for gradually increasing flow into the normal operating range minimize the potential for water hammer downstream of the blowdown control valve while establishing flow during startup.

7. Main Steam System

The main steam piping from the 5 way restraints just outside containment to the main turbine has a minimum slope of 6 inches per 100 feet of piping. 24-inch diameter drip legs are installed upstream of the main turbine inlet on the 24-inch and 30-inch main steam lines to collect and dispense drainage to the condenser. The branch lines that tee off the main steam lines are sloped and contain low point drains to eliminate the possibility of water hammer due to condensate water pockets collecting in low points.

8. Main Feedwater System

Westinghouse has conducted extensive investigations into potential sources of water hammer in preheat steam generators as used on STP. Initiation of main feedwater is controlled by procedure and system interlocks to minimize the potential for water hammer in the main feedwater system.

The routing of the main feedwater piping is in compliance with the Westinghouse criteria for layout, temperature monitoring/alarm, and operational procedures to minimize or eliminate water hammer. Although Westinghouse plants with preheat steam generators have never experienced a bubble collapse type water hammer event in the main feedwater system, the steam generators and feedwater piping are designed for these water hammer events.

9. Main Steam Power-Operated Relief Valves

The steam piping to the inlet of the main steam power operated relief valves is sloped so that condensate drains back into the main steam header when the valve is closed. The valve discharge piping continuously drains to the nearest floor drain.

10. Auxiliary Steam System

The auxiliary steam supply piping is routed through the mechanical auxiliary building with a continuous downward slope to the equipment being supplied to eliminate pockets of condensate. Where low points exist, adequate drain lines and traps are provided to continuously dispense condensate. Consequently, the possibility of water/steam hammer has been minimized.

BENEFITS RESULTING FROM THE ELIMINATION OF ARBITRARY INTERMEDIATE BREAKS

The benefits to be realized from the elimination of the arbitrary intermediate break locations center primarily around the elimination of the associated pipe whip restraints and other structural provisions to mitigate the consequences of these breaks. While a substantial reduction in capital and engineering costs for these restraints and structures can be realized immediately, there are also significant operational benefits to be realized over the 40 year life of the plant. These benefits are summarized below.

A breakdown of the currently postulated arbitrary intermediate pipe breaks being eliminated is provided in Attachment B. Inside containment, a minimum of 88 breaks and 46 restraints are being deleted, leaving approximately 463 breaks and 66 restraints in the design. Outside containment, less than 50 percent of the postulated pipe breaks are arbitrary intermediate breaks. The breaks and restraints being deleted are evenly distributed throughout the plant. Consequently, the remaining breaks and restraints still provide an adequate level of protection in all areas containing high energy lines. The pipe break evaluation effort outside containment has not progressed as far as the work inside containment. This results in our inability to provide specific details on the potential benefits. However, this earlier stage of design means that the decision to eliminate arbitrary intermediate breaks will maximize the resulting benefits. The savings in limited human resources resulting from elimination of these breaks can be more beneficially applied in designing for the effects of the remaining pipe breaks. The total reduction in design, material and erection costs at STP is expected to exceed $5 million.

Access during plant operation for such activities as maintenance and inservice inspection is improved due to the elimination of congestion created by these restraints and the supporting structural steel, and in some cases due to the need to remove some restraints to gain access to welds. In addition to the decrease in maintenance effort, a reduction in man-rem exposure can be realized through fewer manhours spent in radiation areas. The reduction in operational radiation exposure due to the elimination of arbitrary intermediate pipe breaks and the resulting decrease in pipe whip restraints and jet deflectors over the life of both units is conservatively estimated to be well in excess of 100 man-rem. Also, the need to verify adequate cold and hot clearances between pipes and restraint during initial heatup, which requires additional hold points during this already critical startup phase, can be reduced.

Recovery from unusual plant conditions would also be improved by elimination of this congestion. In the event of a radioactive release or spill inside the plant, decontamination operations would be much more effective if the complex shapes, represented by the structural frameworks supporting the restraints, were eliminated. This results in decreasing man-rem exposures associated with decontamination and restoration activities. Similarly, access for control of fires within these areas of the plant would be improved.

By design, whip restraints fit closely around the high energy piping with gaps typically being on the order of half an inch. These restraints and their supporting steel increase the heat loss to the surrounding environment significantly. Also, because thermal movement of the piping system during startup and shutdown could deform the piping insulation against the fixed whip restraint, the insulation must be cut back in these areas, creating convection gaps adjacent to the restraint, which also increases heat loss to the environment. The elimination of whip restraints associated with arbitrary intermediate breaks would assist in controlling the normal environmental temperatures and improve system operational efficiency.