

U.S. NUCLEAR REGULATORY COMMISSION INDIAN POINT 2 NUCLEAR POWER PLANT RESIDENT INSPECTOR'S OFFICE

FACSIMILE TO: Brian Holian.
IN THE OFFICE OF:
TELECOPY NO.:
NUMBER OF PAGES TRANSMITTED INCLUDING THIS FORM:
SUBJECT: Con Ed Calculation
This is part of the information that ConE owed from the regulatory conference. More
owed from the regulatory conference. More
to come. $aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa$
BILL RAYMOND, SENIOR RESIDENT INSPECTOR
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OCT-02-2000 21:21

USNRC INDIAN POINT TWO

CON EDISON CALCULATION / ANALYSIS COVER SHEET

3/16/00

Calculation Number: PGI-00443-00 Entry Date: 03/09/2000

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Type: CA34 PIPE FLOW

> Modification: NONE Scanned: N Revision: NO

Title ESTIMATED PRIMARY TO SECONDARY LEAKAGE DURING TUBE RUPTURE EVENT

Tag Number 24SG

Project Number: NONE

Document Page : 20

Old_Calculation:

ComponentComponentStyleTypeDescriptionStyleDescriptionPIPEPIPETUBETUBE OR TUBING

System Description RCS REACTOR COOLANT SYSTEM

Structure Description VC VAPOR CONTAINMENT BUILDING VCI

174474 Update Date Reviewer: D. C. INGRAM Preparer: R. WA Signature/Date: D Curtin 3/16/00 03/16/2000 Signature: Confirm, Required?----Approval/Date Concurrence (If Required) Page 1

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			Page2 of20_					
		CON EDISON CALCULATI Description of Chang	CON EDISON CALCULATION/ANALYSIS Description of Change Sheet					
· · ·	Calculation No:	PGI-00443-00						
••	Revision No.	Description of Change	Reason for Change					
	0	Initial Release						
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FORM36a :

CON EDISON CALCULATION/ANALYSIS SUMMARY SHEET

	· ·	A REAL PROPERTY AND A REAL				
·		CALCULATION NO. PGI-00443-00	revision 0	PAGE	3 CF	20
PREPARER/DATE	Roger M. Mators Charles Hayes 3/16/00	REVIEWER/DATE D.C. Ing	jrain 3/16/00	Çiməb	NONE	
SUBJECT/TITLE 2/15/00:	Estimated Primary to Secondar	y Leakage Rate During Tube	Rupture Event	PROJECT	NONE	
<i>2</i> ,12,00,				MOD NO.	NOME	rev.
· · · · · · · · · · · · · · · · · · ·						
object of c	ALCULATION:		•			
The intent of thi	s calculation is to provide estima	ates for primary to secondary	leakage rates at va	rious time	periods	throughout the

tube rupture event. These estimates will aid in the SLI team in understanding of the event dynamics.

The total volume of water transferred from the primary side to the secondary side was also estimated.

CALCULATION METHOD/ABBUMPTIONS:

The development of the estimated leakage into 24 Steam Generator (SG) used, where possible, measured plant parameters. The key input parameters were the charging flowrate, letdown flowrate, pressurizer level and the water level in SG 24. The particular parameters used at a given time during the event were those that were determined to be less influenced by the plant transient. These parameters were not adjusted for measurement uncertainties or uncertainties introduced by the transient. As such the tube rupture flowrates determined must be regarded as nominal values.

DESIGN BASIS AND REFERENCES:

- SAS or Proteus data via the Plant Information interface. 1.
- Properties of Saturated and Superheated Steam, Combustion Engineering 2.
- Westinghouse Pressurizer Vendor Manual #1890. 3.
- Graph SP-19, IP2 Steam Generator Volume versus Level. 4.

CONCLUSIONS:

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The flowrate through the suptured tube varied throughout the event. The highest flowrate was encountered prior to the reactor trip and was estimated to be 109 gpm. After the reactor trip and prior to the manual SI the primary to secondary side pressure drop decreased and the flowrate decreased to an estimated 91 gpm. After the manual SI the primary to secondary side pressure drop decreased rapidly and consequently so did the flowrate. At times between the SI and Cold Shutdown this pressure drop was positive, zero or negative, When the pressure drop was negative there was back flow between SG 24 and the RCS. Between SI and Cold Shutdown the estimated flowrate varied between 70 gpm and 0 gpm.

The volume of water transferred from the primary side to the secondary side were estimated as follows:

Tube Rupture to Reactor Trip	1313 gallons
Reactor Trip to Manual SI	8685 gallons
Manual SI to Cold Shutdown	9199 gallons

The total volume of primary side water transferred to the secondary side is therefore estimated at 19200 gallons.

FORM35

Summary		:		Average		<i> </i>
· · · ·	Event Period	Time	Primary to Se		 Volume (gallons)** 	
				(gpm)*		
	Tube Rupture to Reactor Trip	19:17 to 19:29		109	1313	
	Reactor Trip to Manual SI	19:29 to 21:04	•	91	8685	
· · ·	Post SI	21:04 to 21:30		70	1824	
	Post SI	21:30 to 22:00		37	1120	
	Post SI	22:00 to 22:30		.7	200	
· · · ·	Post Sl	22:30 to 23:00		- 3	80	
· · · · · · · · · · · · · · · · · · ·	Post SI	23:00 to 23:30		4	120	
		23:30 to 06:00	· . ·	0	Ð	•
	Post SI	06:00 to 07:00		11 ·	655	
	Post SI	07:00 to 12:30		11	3600	
	Post SI		•	18	1600	•
	Post SI	12:30 to 14:00	_	ι.σ Λ	0	
	Post SI	14:00 to Cold Shutdow	या .		· . •	• • • • •

The total volume of primary to secondary leakage =

19197 gallons**

"The leak rates calculated are in given in gpm of "cold" water (100 F and atmospheric pressure).

"The water volumes calculated are given in gallons of "cold" water (100 F and atmospheric pressure).

Introduction

1

The primary to secondary leakage rates during the tube rupture event are calculated. Inputs to the calculation are from measured plant parameters. The origin of each calculation input is identified in the body of the calculation. Figures 1 through 7 show some of the measured plant parameters that are used or referred to in this calculation. These Figures originate from SAS or Proteus (Ref. 1).

The tube rupture flowrate was estimated for four periods:

- Just Prior to Tube Rupture
- 2 From Tube Rupture to Reactor Trip
- 3 From Reactor Trip to Manual SI
- 4 From Manual SI to Cold Shutdown

The calculations for each of these time periods are now presented.

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	Just Prior to Tube Rup	ure					• •	
One Charging Put								· · · · · · ·
Pressunzer Level				· · · · · · · · · · · · · · · · · · ·		• •		•••
Charging Flow		rom computer point	t F0128 - see Fi	gure 21				
Letdown Flow	87 gpm (F	rom computer point	t FUT34 - See FI	gure 2)	• .	• . :		··· ·
During steady sta	te at power operation the total	inflow to the HCS I	s maicned by in					•••••••••••••••••••••••••••••••••••••••
	given by the charging flow as	moretimed on E012	lees off suin R	ntection flow retur	Tred to the			
I ne total innow is	o shaft. The seal injection flow	measured on the RC	S is given by the	adiference	· · · ·		. .	· · ·
HCO via me hrmi	easured charging and letdowr	flowrates						
Detween me as in	leasured charging and leaden	· Itemataion	•	• • •	•			
Therefore, seal in	jection returned to RCS =	28 gpm			·	•		
1110,01010,000					· ·· ·		• •	
•			·. · · · · ·					
Time Period	From Tube Rupture to	Reactor Trip (19:1	7 to 19:29)					
		•						
Determine avera	ige charging flow (19:17 to 1	9:29)						•
	· · · ·	•						·
Charging Flow fro	om SAS computer point F0128	(See Figure 2).						·
Charging Flow fro	· · · ·	(See Figure 2).	was started.					·
Charging Flow fro	om SAS computer point F0128 reased abrupily when the seco	(See Figure 2). and charging pump	was started.					
Charging Flow fro Charging flow inc 19:17 to 19:19	orn SAS computer point F0128 reased abrupily when the seco 61 gpm for	(See Figure 2).	was started.		· · ·			
Charging Flow fro Charging flow inc 19:17 to 19:19 19:19 to 19:20	om SAS computer point F0128 reased abrupily when the seco 61 gpm for 80 gpm for	(See Figure 2). and charging pump 2 minutes	was started.		· · ·			
Charging Flow fro Charging flow inc 19:17 to 19:19 19:19 to 19:20 19:19 to 19:21	om SAS computer point F0128 reased abrupily when the seco 61 gpm for 80 gpm for 118 gpm for	(See Figure 2). and charging pump 2 minutes 1 minutes	was started.		· · ·			
Charging Flow fro Charging flow inc 19:17 to 19:19 19:19 to 19:20	om SAS computer point F0128 reased abrupily when the seco 61 gpm for 80 gpm for	(See Figure 2). and charging pump 2 minutes 1 minutes 1 minutes 1 minutes	was started.		· · ·			

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147 gpm

Determine average seal injection flow returned to RCS (19:17 to 19:29)

The seal injection flow returned to the RCS increases (scales) as the charging flow increases

Therefore the seal inj. returned flow scaling factor is100 divided by 60Therefore the seal inj. return flow during this period is28 times1.67

Determination of total inflow to RCS from charging system (19:17 to 19:29)

The total inflow is the sum of the charging flow and the seal inj. returned flow

Therefore, total inflow = 100 plus 47 =

Letdown Flow (19:17 to 19:29)

Letdown Flow from SAS computer point F0134 (See Figure 2).

Letdown Flow remained constant during this period = 87 gpm

Pressurizer Level (19:17 to 19:29)

Pressurizer Level from SAS computer point L0480 (See Figure 3).

The pressurizer level decreased significantly during the period.

19:17 to 19:29 Level decreased from 43.4 % to 35.5 %

Assuming that 1% level is equivalent to 126 gallons of "hot" water (650 F and 2235 psig). [Based on distance between taps and inside diameter from Ref. 3.]

Then, equivalent volume of "cold" water is 75.6 gallons (Conversion "hot" to "cold" from Ref. 2).

Then this level reduction is equivalent to an inventory change of -597 gallons of "cold" water

for

At an average rate of

-50 gpm

12 minutes

1313 callons

Estimation of primary to secondary flow rate during this period (19:17 to 19:29)

Total Inflow to RCS = Letdown Flow + Tube Rupture Flow + Pressurizer Inventory Change

Therefore, Tube Rupture Flow = Total Inflow to RCS - Letdown Flow - Pressuitzer Inventory Change

Tube Rupture Flow =147 minus87minus-50=Total primary to secondary leakage volume during this period=

Time Period From Reactor Trip to Manual SI (19:29 to 21:04)

Determine average charging flow (19:29 to 21:04)

Charging Flow from SAS computer point F0128 (See Figure 2).

Charging flow varies between 120 gpm and 75 gpm.

Therefore, average charging flow =

19:29 to 19:38	119 gpm for	9 minutes				
19:38 to 19:52	94 gpm for	14 minutes				
19:52 to 20:08	82 gpm for	16 minutes				
20:08 to 20:31	104 gpm for	23 minutes		·		
20:31 to 21:00	85 gpm for	29 minutes				
21:00 to 21:04	115 gpm for	4 minutes	·			

for

95 minutes

Determine average seal injection flow returned to RCS (19:29 to 21:04)

The seal injection flow returned to the RCS increases (scales) as the charging flow increases

Therefore the seal inj. returned flow scaling factor is	95 divided by 60)	~	1.58	
Therefore the seal init return flow during this partial is	28 times 1.	58	=	44	gpm

95 gpm

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· ·		,			• • •						•,
•				I John During	Tube Rupture Event C	Seculation 8	GL00883-	na			
· ·	· · · · · ·	Estimated Primi	iry to Secondary	, гажаде пинид					·.		٠
					· · · · · · · · · · · · · · · · · · ·	· · ·					· · · · ·
	Determination of tota	al inflow to RCS from ch	arging system (19:29 to 21:04)		· ·'	· • • •			: ·	0 1
	The total inflow is the	sum of the charging flow a	nd the seat inj. re	etumed flow	· · · · · · · · · · · · · · · · · · ·		· · · · · · · · · · ·		· · · · · · · · ·		
· · · · · · · ·	Therefore, total inflow	= 95 ph	IS	44 -	139 gpm				. . . [.]	•	ſ
	Letdown Flow (19:29	9 to 21:04)	. <i>.</i>	• • • • • • • • • • • •		۰ - ۲۰ ۱۹۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ -	· · · · · · · · · · ·				
• • • •	Letdown Flow from SA	AS computer point F0134	See Figure 2).			· · · · · ·	·		• • •		
	Letdown flow dropped	t to zero and reestablished	at 41 gpm.	·				. · ·			
	19:29 to 19:32 19:32 to 19:41 19:41 to 21:04	34 gpm for 14 gpm for 41 gpm for	3 minutes 9 minutes 83 minutes	5		•		· ·			
	Therefore, average le	tdown flow =	38 gpm	for	95 minutes	:	•			·	
	Pressurizer Level (1	9:29 to 21:04)									
	Pressurizer Level from	n SAS computer point L04	80 (See Figure 3).			•				
	After the trip the press	sutizer level recovered fro	m 14 % to 35% a	nd then decreased	to 26% at SI						
÷	19:29 to 21:04	Level increased from	14 %	" to	26 %			•••			
	Assuming that 1% lev [see above.]	vel is equivalent to	126 gallons	of "hot" water							
	Then, equivalent volu	ume of "cold" water is	75.6 gallons	;				•			
	Then this level increa	ise is equivalent to an inve	ntory change of	907 gal	lions of "cold" water						
	At an average rate o	t 10 gpm fo	5 7	95 minutes							
	·							••			

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	Estimated Primary to Secondary Lea	kage punng tu	ide Rupture i		iculation P	454443-00	· · ·		·
Estimation of primary	to secondary flow rate during this period (1	19:29 to 21:04)	·				· ·	. <u>.</u> .	
Total inflow to RCS = L	etdown Flow + Tube Rupture Flow + Pressunz	er Inventory Cha	nge					· · · ·	· . ·
Therefore, Tube Ruptu	re Flow = Total Inflow to RCS - Leidown Flow-	Pressurizer Inve	intory Change	•	•		··· ·	• •	
Tube Rupture Flow = Total primary to second	139 minus 38 minus lary leakage volume during this period	10	= 86	91 gpm 85 gallon:		· · · · · ·	· · · · · · · · · · · · · · · · · · ·	• •	·
it is concluded that the pressurizer and possib a secondary side balar accurate result as the s	y is appropriate for time periods prior to St. For pressurizer level measurements are inaccurate to steam intrusion into the instrument's reference ice is used to determine leak rate for the period steam generator was isolated by closing the MS lown prior to this time period.	e due to the empty te leg. Conseque ls after SI. This g	entiy,		· ·	· · ·			
secondary side leakad	is isolated then the level increase in the genera a and the leakage rate can be determined from he relationship between SG WR level and gallo	the SG 24 level	uted to prima increase.	ry to		•			
Time Period	Post Manual SI (21:04 to 21:30)								
Steam Generator 24 L	evel from SAS computer point L0463 (See Figu	1 re 6) .					•		
21:04 to 21:30	Steam generator level increased from approxit	nately	62.5 to-		68.2 %				
	Assuming 1% wide range level is equivalent to [Based on Graph SP-19].	320 gailons the	n the volume	increase (over				

 1824 gailons
 70 gpm 26 minute period was this or

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				·				
Time Period	Post Manua	l SI (21:30 to 22:00)	, 1. 		•			· ··· · · ·
Steam Generator 24	Level from SA	S computer point L0	463 (See F	igure 6).		مرجع مرجع و ماه منبعه المرجع مرجع المرجع	an a	· · · · · · · · · · · · · · · · · · ·
21:30 to 22:00	Steam gener	ator level increased	from appro	ximately	68,2 to	71.0 %		· · · · · · · · · · · ·
	Assuming 19 [Based on G		equivatent	to 400 gallo	ns then the volume increa	se over	· · · · · · · · · · ·	· ·
	this .	· 30 minute	period	was ' of	1120 gailons 37 gpm			
Time Period	Post Manua	il <u>51 (22:00 to 22:30</u>)) ·		·	· ·		
Steam Generator 24	Lavel from SA	S computer point L0	463 (See f	Figure 6).				
21:30 to 22:00	Steam gener	rator level increased	from appro	oximately	71.0 to	71.5 %		
	Assuming 19 [Based on G	% wide range level is iraph SP-19].	equivalen	it to 400 gallo	ns then the volume increa	se over	· .	
	this '	· · · 30 minute	-period	was or	200 gáltons 7 gpm			
Time Period	Post Manua	al SI (22:30 to 23:00)				•	
Steam Generator 24	Level from SA	S computer point L0	463 (See	Figure 6).				
22:30 to 23:00	Steam gene	rator level increased	from appr	oximately	71.5 to	71.7 %		
		% wide range level k Traph SP-19].	s equivaler	nt to 400 gallo	ons then the volume increa	ase over		
	this	30 minute	period	was of	80 gallons 3 gpm			

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		Estimated Primary	to Secondary	Leakage Durin	g tape Kabrate E	vent Calculation	FCI-00443-0	u	•	•
	· · ·		· ·	•	· · ·	· · · ·				
				· · ·						
÷	Time Period	Post Manual SI (23:00 to 23	:30)	· · · · ·	· · · · ·					
	Steam Generator 24 I	Level from SAS computer poin	t L0463 (See F	īgure 6).	· · · · · · ·	•	•			· · ·
1.1 5 - 2	23:00 to 23:30	Steam generator level increa	sed from appro	ximately	71.7 to	72.0 %		· · · ·	· ·	· · · · · · · · · · · · · · · · · · ·
		Assuming 1% wide range lev [Based on Graph SP-19].	el is equivalent	to 400 gailons	then the volume in	crease over	• • •	· · · · · · ·	-	· · · · · · · · · · · · · · · · · · ·
• •		this 30 minute	e period	1785 Of	120 gallons 4 gpm	•• • ••• .		· · ·		· · · · · ·
	Time Period	Post Manual SI (23:30 to Di	(00)		·. ·			• •		
	23:30 to 06:00	Steam generator and RCS p Steam generator level chang backfill from SG 24 and addit (See Figures 1 and 7).	es are therefor	e not due to lea	kage and cannot b	e used. RCS				
		For this time period of	390 minutes	there was or	0 gallons tr 0 gpm.	ansterred.				
	Time Period	Post Manual St (06:00 to 07	(:00)				·		•	
	06:00 to 07:00	Steam generator level is incr primary to secondary leakage (See Figure 1).	easing due to t e. Assume leak	he addition of a rate equal to the	uxillary feedwater a nat between 07:00 :	and the and 12:30.				
		For this time period of	60 minutes	there was or	655 gallons tr 11 gpm.	ansferred.				

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		mared tuniary to	Secondary	r Leakage Dur	ing Tube Rupture	Event Calculation	1 PGI-00443-00		
• • •		•	•••••	· · · · · · · · · · ·	······································				
Time Period	Post Manua	al 51 (07:00 to 12:3	0).	· · ·				· · · · · ·	
Steam Generator 24	4 Level from SA	S computer point L	0463 (See	Figure 1).		· · · ·			
07:00 to 12:30	Steam gene	rator level increase	d from appr	oximately	81.0 to	90.0 %			
	Assuming 19 (Based on G	% wide range level iraph SP-19],	is equivalen	nt to 400 gallon	is then the volume l	nciease over		· · · · · · · · · · · · · · · · · · ·	
	this	330 minute	period	Was or	3600 gallons 11 gpm				· · · · ··
Time Period	Post Manua	ul SI (12:30 to 14:0	D)			· · ·			
	there was all suggested c	so a substantial prin ontinued leakage. It s in the previous tim	mary to sec t is conserva	ondary side pr ative to assum	e that leakage cont	would inued at the	:		
12:30 to 14:00	there was al suggested co same rate as	so a substantial prir ontinued leakage. I	mary to sec t is conserv ne period. A	ondary side pr ative to assum n "artificial" iev	essure drop which e that leakage coni	would inued at the			
12:30 to 14:00	there was al suggested co same rate as Steam gener	so a substantial prin ontinued leakage. It s in the previous tim	mary to sec t is conserve ne period. A d from appr	ondary side pr ative to assum n "artificiai" iev oximately	essure drop which the that leakage control vel is therefore used 90.0 to	would linued at the 1 in this calculation. 94.0 %	:		
12:30 to 14:00	there was al suggested co same rate as Steam gener	so a substantial prir ontinued leakage. It s in the previous tim rator level increased	mary to sec t is conserve ne period. A d from appr	ondary side pr ative to assum n "artificiai" iev oximately	essure drop which the that leakage continue that leakage continue that leakage continues which the teacher of teacher	would linued at the 1 in this calculation. 94.0 %			
12:30 to 14:00 Time Period	there was all suggested or same rate as Steam gener Assuming 19 this	so a substantial prir ontinued leakage. It s in the previous tim rator level increased % wide range level i	mary to sec t is conserva- ne period. A d from appro- is equivalen period	ondary side pr ative to assum n "artificial" lev oximately It to 400 gallor was or	essure drop which the le that leakage cont yel is therefore used 90.0 to is then the volume i 1600 gallons	would linued at the 1 in this calculation. 94.0 %			
	there was all suggested or same rate as Steam gener Assuming 19 this Post Manua Steam gener	so a substantial prin ontinued leakage. It s in the previous tim rator level increased % wide range level i 90 minute II SI (14:00 to Cold rator and RGS pres here was no primary	many to sec t is conserva- ne period. A d from appr is equivalen period I Shutdowr sure were a	ondary side pr ative to assum n "artificial" lev oximately at to 400 gallor was or b)	essure drop which the le that leakage continued is therefore used 90.0 to is then the volume in 1500 gallons 18 gpm	would inued at the 1 in this calculation 94.0 % Increase over	·		

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Figures

	Figure 1	RCS Wide Range Pressure, Steam Generator 24 Outlet Pressure, Loop 1 Cold Leg Temperature (WR),	:
		RHR Hx Header Temperature and Steam Generator 24 Wide Range Level. 18:00 2/15/00 to 18:00 2/16/00.	
	Figure 2	Charging and Letdown Flow 19:00 to 24:00 2/15/00.	
······································		Pressunzer Level 19:00 to 24:00 2/15/00. Steam Generator 24 Pressure 19:00 to 24:00 2/15/00.	
	Figure 5	RCS Pressure 19:00 to 24:00 2/15/00.	•
Figi	Figure 6	Steam Generator 24 Wide Range Level 19:00 to 24:00 2/15/00.	
	Figure 7	Steam Generator 24 Wide and Narrow Range Level, Pressure and AFW Flow 19:00 to 21:00 2/15/00.	

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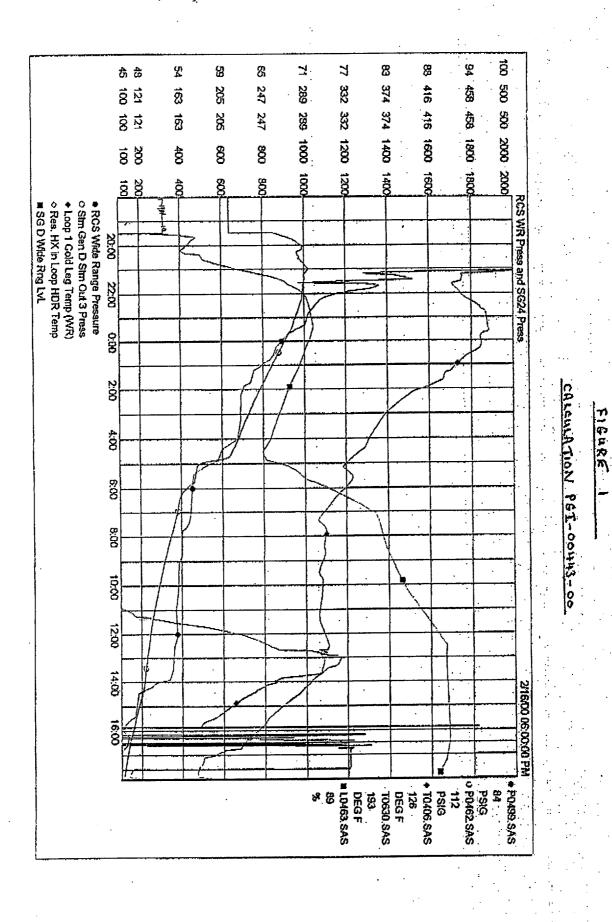
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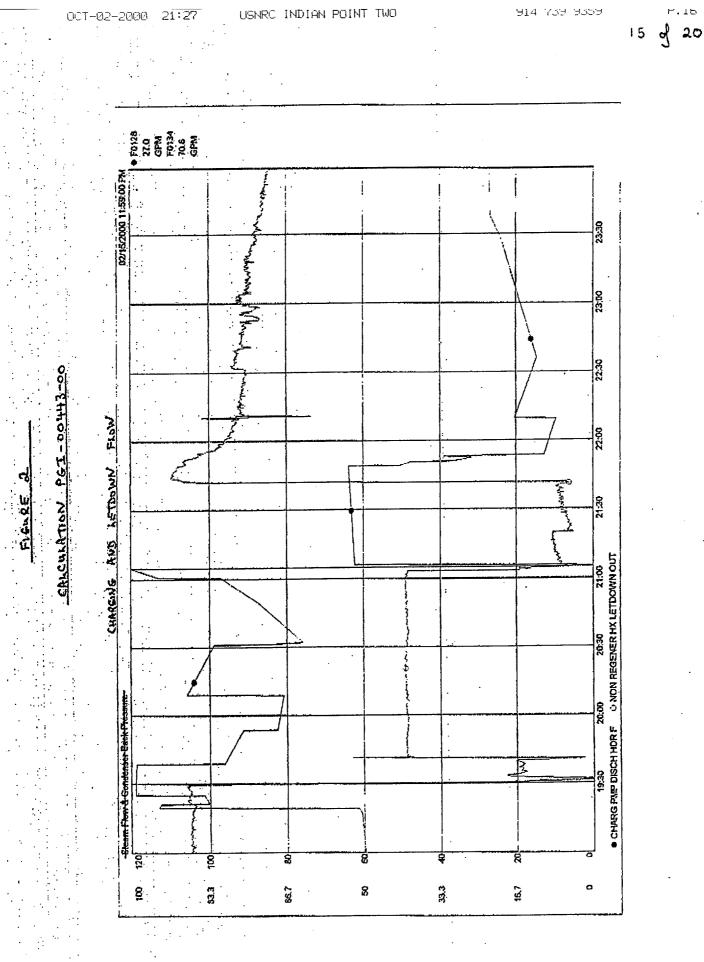


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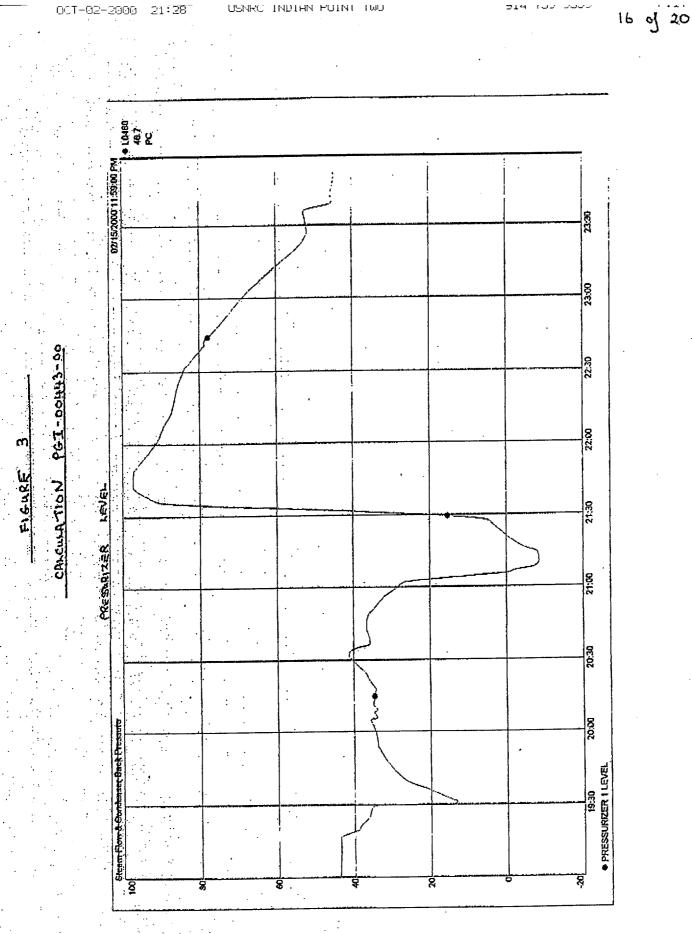
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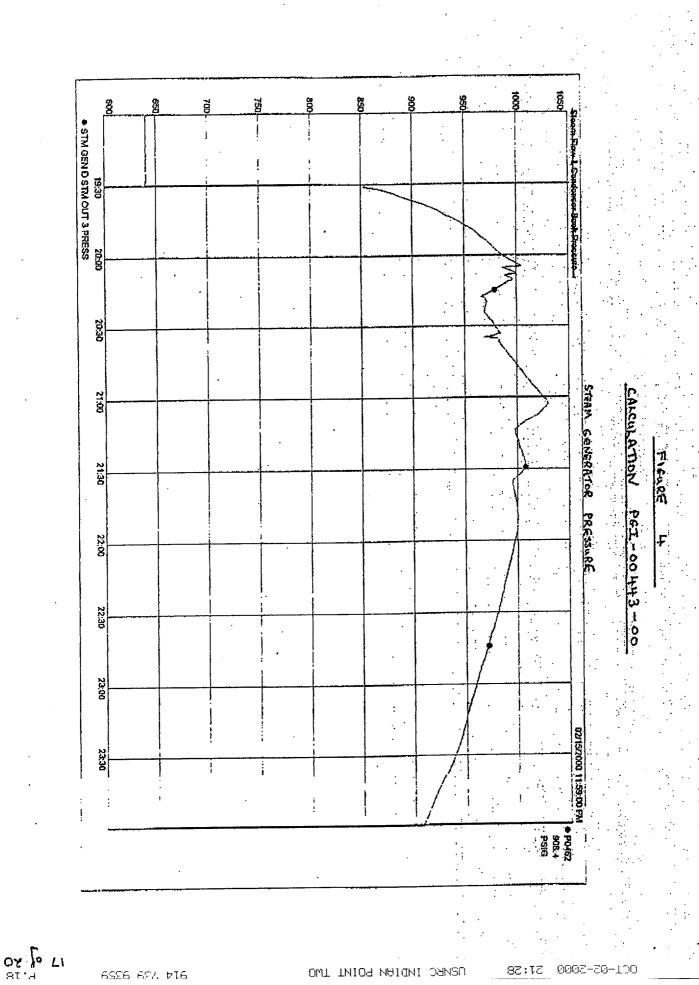
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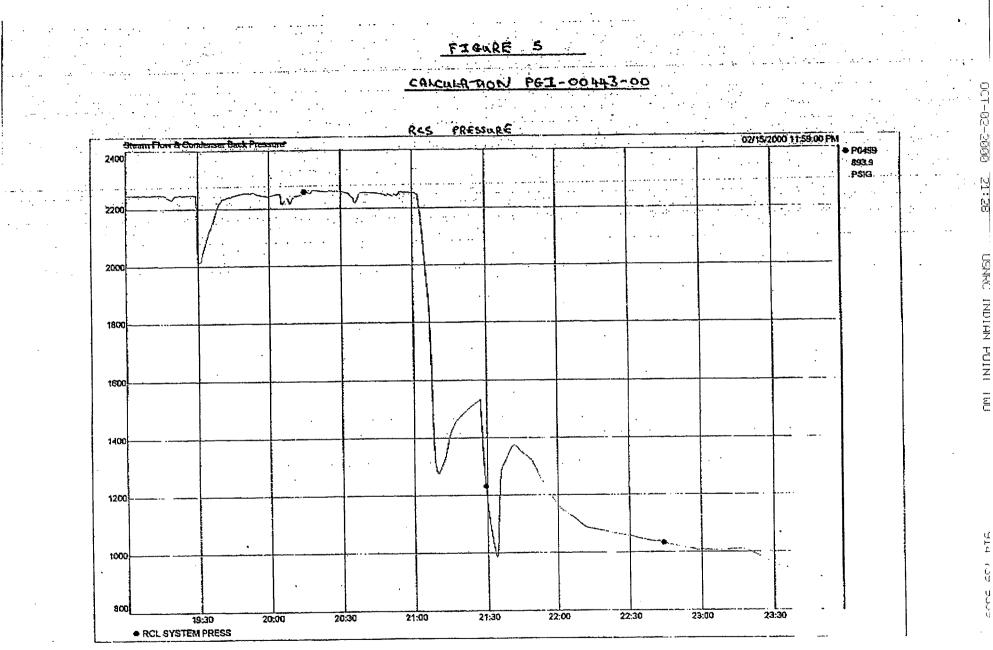
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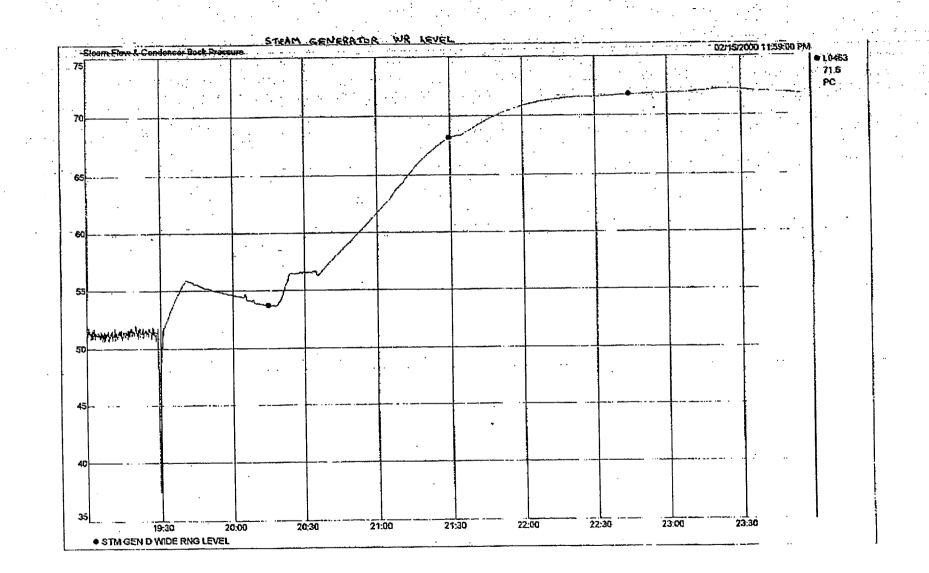
57:58 0002-20-100



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FIGURE 6 CANCULATION PGI-00443-



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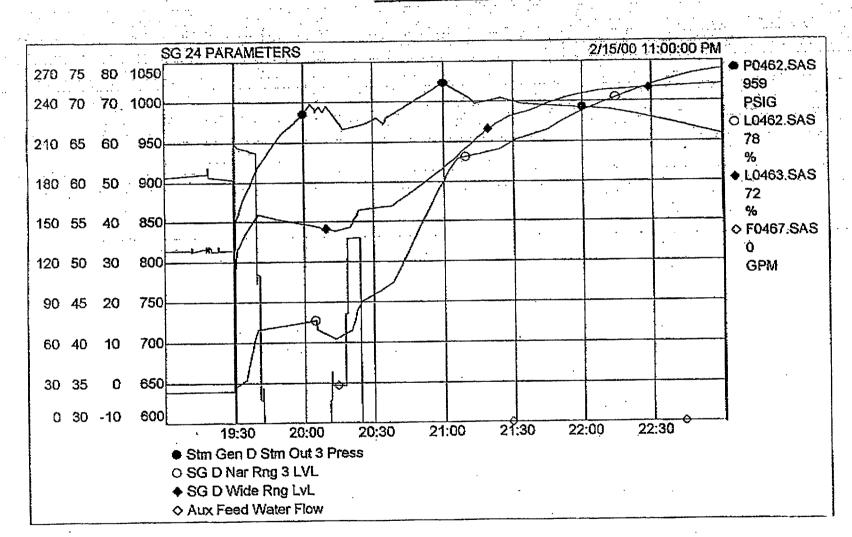
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CALCULATION PET-00443-00

FIGURE



TOTAL P.21

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