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AMPCO

EB-2010-0008

CROSS-EXAMINATION OF

OPG PANEL 4

COMPENDIUM OF MATERIAL

DAVIS LLP

DAVID CROCKER

INDEX

Numbers may not add due to rounding.

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Table 2
Outage OM&A by Resource Type - Nuclear ($M)
Plan - Calendar Year Ending December 31, 2012

Line No.	Division	Regular Labour	Non-Regular Labour	Overtime	Augmented Staff	Materials	Other Purchased Services	Other	Total Outage OM&A
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
	Nuclear Stations								
1	Darlington NGS		4.6	11.2		11.5	31.5	0.3	59.0
2	Pickering A NGS					5.9	46.5		52.4
3	Pickering B NGS		2.8	12.0	3.7	12.5	43.9		74.9
4	Pickering B Continued Operations					5.1	5.5		10.6
5	**Total Stations**	0.0	7.3	23.2	3.7	34.9	127.5	0.3	196.9
	Nuclear Support Divisions								
6	Engineering						1.1		1.1
7	Projects & Modifications		0.2	1.0			(0.1)		1.1
8	Facilities Management			0.1					0.1
9	Programs & Training			0.5					0.5
10	Supply Chain			1.4					1.4
11	Performance Imprvmnt & Oversight								0.0
12	Inspection & Mtce Services[1]								0.0
13	Commercial Services								0.0
14	Nuclear Level Common								0.0
15	**Total Support**	0.0	0.2	3.1	0.0	0.0	1.0	0.0	4.2
16	**Total**	0.0	7.5	26.3	3.7	34.9	128.5	0.3	201.1

Notes:
1 Station costs include Inspection & Maintenance Services outage support.

Table 3
Outage OM&A by Resource Type - Nuclear ($M)
Plan - Calendar Year Ending December 31, 2011

Line No.	Division	Regular Labour	Non-Regular Labour	Overtime	Augmented Staff	Materials	Other Purchased Services	Other	Total Outage OM&A
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
	Nuclear Stations								
1	Darlington NGS		5.4	11.9		11.5	35.1	0.2	64.2
2	Pickering A NGS					6.4	45.6		52.0
3	Pickering B NGS		6.2	12.7	2.9	12.5	46.9		81.1
4	Pickering B Continued Operations					4.4	8.5		13.0
5	**Total Stations**	0.0	11.6	24.6	2.9	34.8	136.1	0.2	210.2
	Nuclear Support Divisions								
6	Engineering						1.1		1.1
7	Projects & Modifications		0.2	1.3			(0.0)		1.5
8	Facilities Management			0.1					0.1
9	Programs & Training			0.5					0.5
10	Supply Chain			1.4					1.4
11	Performance Imprvmnt & Oversight								0.0
12	Inspection & Mtce Services[1]								0.0
13	Commercial Services								0.0
14	Nuclear Level Common								0.0
15	**Total Support**	0.0	0.2	3.3	0.0	0.0	1.1	0.0	4.6
16	**Total**	0.0	11.8	27.9	2.9	34.8	137.2	0.2	214.8

Notes:
1 Station costs include Inspection & Maintenance Services outage support.

Numbers may not add due to rounding.

Table 4
Outage OM&A by Resource Type - Nuclear ($M)
Budget - Calendar Year Ending December 31, 2010

Line No.	Division	Regular Labour	Non-Regular Labour	Overtime	Augmented Staff	Materials	Other Purchased Services	Other	Total Outage OM&A
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
	Nuclear Stations								
1	Darlington NGS		10.6	20.9		16.6	58.4	0.2	106.7
2	Pickering A NGS		5.4	11.0	0.4	14.8	37.1	0.0	68.6
3	Pickering B NGS		6.6	17.5	2.7	15.3	48.5	0.0	90.5
4	Pickering B Continued Operations					1.4	0.5		1.9
5	**Total Stations**	0.0	22.5	49.4	3.1	48.1	144.5	0.3	267.8
	Nuclear Support Divisions								
6	Engineering						1.1		1.1
7	Projects & Modifications		0.4	1.8			0.9		3.1
8	Facilities Management			0.1		0.0	0.2		0.3
9	Programs & Training		0.0	0.5	0.0		0.2		0.8
10	Supply Chain			1.6					1.6
11	Performance Imprvmnt & Oversight								0.0
12	Inspection & Mtce Services[1]								0.0
13	Commercial Services								0.0
14	Nuclear Level Common						10.0		10.0
15	**Total Support**	0.0	0.4	4.0	0.0	0.0	12.4	0.0	16.8
16	**Total**	0.0	22.9	53.4	3.1	48.1	156.8	0.3	284.6

Notes:
1 Station costs include Inspection & Maintenance Services outage support.

Table 5
Outage OM&A by Resource Type - Nuclear ($M)
Actual - Calendar Year Ending December 31, 2009

Line No.	Division	Regular Labour	Non-Regular Labour	Overtime	Augmented Staff	Materials	Other Purchased Services	Other	Total Outage OM&A
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
	Nuclear Stations								
1	Darlington NGS		6.6	20.8	0.3	14.2	66.7	1.2	109.8
2	Pickering A NGS		3.1	10.1	16.8	4.5	29.6	0.0	64.1
3	Pickering B NGS		4.9	16.5	1.1	12.0	35.6	0.1	70.2
4	Pickering B Continued Operations					2.5	0.3	0.0	2.8
5	**Total Stations**	0.0	14.6	47.3	18.2	33.1	132.3	1.4	246.8
	Nuclear Support Divisions								
6	Engineering			0.1			1.0		1.1
7	Projects & Modifications		0.9	2.0	0.0				2.9
8	Facilities Management		0.1	0.1		0.0			0.2
9	Programs & Training		0.1	0.7			0.2		1.0
10	Supply Chain		0.5	2.2	0.0				2.8
11	Performance Imprvmnt & Oversight								0.0
12	Inspection & Mtce Services[1]								0.0
13	Commercial Services								0.0
14	Nuclear Level Common								0.0
15	**Total Support**	0.0	1.7	5.1	0.0	0.0	1.2	0.0	8.0
16	**Total**	0.0	16.2	52.4	18.2	33.1	133.4	1.4	254.8

Notes:
1 Station costs include Inspection & Maintenance Services outage support.

Numbers may not add due to rounding.

Table 6
Outage OM&A by Resource Type - Nuclear ($M)
Budget - Calendar Year Ending December 31, 2009

Line No.	Division	Regular Labour	Non-Regular Labour	Overtime	Augmented Staff	Materials	Other Purchased Services	Other	Total Outage OM&A
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
	Nuclear Stations								
1	Darlington NGS		4.0	16.5	3.6	10.7	32.6	4.5	71.8
2	Pickering A NGS		2.5	6.6		5.3	46.7		61.1
3	Pickering B NGS		2.4	11.0	3.6	10.0	43.5		70.5
4	Pickering B Continued Operations								0.0
5	**Total Stations**	0.0	9.0	34.1	7.2	25.9	122.8	4.5	203.4
	Nuclear Support Divisions								
6	Engineering						1.1		1.1
7	Projects & Modifications						1.6		1.6
8	Facilities Management			0.1					0.1
9	Programs & Training			0.4					0.4
10	Supply Chain			1.4					1.4
11	Performance Imprvmnt & Oversight								0.0
12	Inspection & Mtce Services[1]								0.0
13	Commercial Services								0.0
14	Nuclear Level Common								0.0
15	**Total Support**	0.0	0.0	1.9	0.0	0.0	2.6	0.0	4.5
16	**Total**	0.0	9.0	35.9	7.2	25.9	125.5	4.5	207.9

Notes:
1 Station costs include Inspection & Maintenance Services outage support.

Numbers may not add due to rounding.

Table 7
Outage OM&A by Resource Type - Nuclear ($M)
Actual - Calendar Year Ending December 31, 2008

Line No.	Division	Regular Labour	Non-Regular Labour	Overtime	Augmented Staff	Materials	Other Purchased Services	Other	Total Outage OM&A
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
	Nuclear Stations								
1	Darlington NGS		4.2	13.8	0.5	22.2	42.4	0.1	83.2
2	Pickering A NGS		1.2	3.1	5.1	6.8	8.7	0.0	25.0
3	Pickering B NGS		6.7	19.5	0.5	15.1	41.0	0.1	82.9
4	Pickering B Continued Operations								0.0
5	**Total Stations**	0.0	12.1	36.4	6.2	44.1	92.1	0.2	191.1
	Nuclear Support Divisions								
6	Engineering			0.0	0.0		1.2		1.2
7	Projects & Modifications		0.3	1.4		0.1	(0.0)		1.8
8	Facilities Management		0.0	0.0					0.1
9	Programs & Training		0.0	0.5		0.0		0.0	0.6
10	Supply Chain		0.1	1.2					1.3
11	Performance Imprvmnt & Oversight								0.0
12	Inspection & Mtce Services[1]								0.0
13	Commercial Services								0.0
14	Nuclear Level Common								0.0
15	**Total Support**	0.0	0.5	3.1	0.0	0.1	1.2	0.0	5.0
16	Total	0.0	12.6	39.6	6.2	44.1	93.3	0.3	196.1

Notes:
1 Station costs include Inspection & Maintenance Services outage support.

Numbers may not add due to rounding.

Table 8
Outage OM&A by Resource Type - Nuclear ($M)
Budget - Calendar Year Ending December 31, 2008

Line No.	Division	Regular Labour	Non-Regular Labour	Overtime	Augmented Staff	Materials	Other Purchased Services	Other	Total Outage OM&A
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
	Nuclear Stations								
1	Darlington NGS		4.0	11.7	0.6	19.8	35.6	0.7	72.4
2	Pickering A NGS		2.4	6.3		5.0	34.7		48.5
3	Pickering B NGS		4.4	12.9		11.0	38.4		66.7
4	Pickering B Continued Operations								0.0
5	**Total Stations**	0.0	10.8	30.9	0.6	35.8	108.7	0.7	187.5
	Nuclear Support Divisions								
6	Engineering						1.0		1.0
7	Projects & Modifications						1.6		1.6
8	Facilities Management			0.1					0.1
9	Programs & Training			0.6				0.0	0.6
10	Supply Chain			1.3					1.3
11	Performance Imprvmnt & Oversight								0.0
12	Inspection & Mtce Services[1]								0.0
13	Commercial Services								0.0
14	Nuclear Level Common								0.0
15	**Total Support**	0.0	0.0	1.9	0.0	0.0	2.6	0.0	4.6
16	**Total**	0.0	10.8	32.8	0.6	35.8	111.4	0.7	192.2

Notes:
1 Station costs include Inspection & Maintenance Services outage support.

Numbers may not add due to rounding.

Table 9
Outage OM&A by Resource Type - Nuclear ($M)
Actual - Calendar Year Ending December 31, 2007

Line No.	Division	Regular Labour	Non-Regular Labour	Overtime	Augmented Staff	Materials	Other Purchased Services	Other	Total Outage OM&A
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
	Nuclear Stations								
1	Darlington NGS		6.9	20.9	1.0	15.7	52.5	0.1	97.1
2	Pickering A NGS		3.0	7.0	1.1	5.3	25.7	0.0	42.1
3	Pickering B NGS		4.2	15.9	5.5	13.7	30.3	0.1	69.6
4	Pickering B Continued Operations								0.0
5	**Total Stations**	0.0	14.1	43.7	7.6	34.7	108.5	0.2	208.8
	Nuclear Support Divisions								
6	Engineering			0.0	0.0		1.6		1.6
7	Projects & Modifications		0.6	1.2		0.0	0.8	0.0	2.6
8	Facilities Management		0.0	0.1			(0.0)		0.0
9	Programs & Training		0.4	0.4	0.1	0.0		0.0	1.0
10	Supply Chain		0.0	1.6	0.0	0.0			1.6
11	Performance Imprvmnt & Oversight								0.0
12	Inspection & Mtce Services[1]								0.0
13	Commercial Services								0.0
14	Nuclear Level Common								0.0
15	**Total Support**	0.0	1.0	3.3	0.1	0.0	2.4	0.0	6.8
16	**Total**	0.0	15.1	47.1	7.7	34.7	110.9	0.2	215.6

Notes:
1 Station costs include Inspection & Maintenance Services outage support.

Numbers may not add due to rounding.

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Exhibit E2
Tab 1
Schedule 2
Table 1a

Table 1a
Comparison of Production Forecast - Nuclear

Line No.	Prescribed Facility	2007 Budget	(c)-(a) Change	2007 Actual	(e)-(c) Change	2008 Actual	(e)-(g) Change	2008 Budget
		(a)	(b)	(c)	(d)	(e)	(f)	(g)
	Darlington NGS							
1	**TWh**	26.8	0.4	27.2	1.6	28.9	0.3	28.6
2	**Unit Capability Factor (%)**	87.3	2.2	89.5	5.1	94.5	1.7	92.8
3	**PO Days**	131.0	3.3	134.3	(65.2)	69.1	(6.0)	75.1
4	**FEPO Days**	0.0	2.7	2.7	(2.7)	0.0	0.0	0.0
5	**FLR (%)**	4.1	(3.0)	1.14	(0.4)	0.7	(1.5)	2.24
6	**FLR Days Equivalent**	44.4	(29.3)	15.1	(5.2)	9.9	(21.3)	31.1
	Pickering A NGS							
7	**TWh**	7.5	(3.9)	3.6	2.8	6.4	(0.7)	7.1
8	**Unit Capability Factor (%)**	83.7	(42.3)	41.3	30.5	71.8	(7.2)	79.0
9	**PO Days**	66.2	(1.1)	65.1	(65.1)	0.0	(67.0)	67.0
10	**FEPO Days**	0.0	60.2	60.2	(59.1)	1.1	1.1	0.0
11	**FLR (%)**	8.0	41.8	49.8	(21.9)	27.9	14.9	13.0
12	**FLR Days Equivalent**	53.1	246.6	299.7	(96.6)	203.1	116.6	86.4
	Pickering B NGS							
13	**TWh**	15.6	(2.2)	13.4	(0.5)	12.9	(2.8)	15.7
14	**Unit Capability Factor (%)**	86.3	(11.4)	75.0	(3.6)	71.4	(15.2)	86.6
15	**PO Days**	121.0	10.8	131.8	(69.7)	62.1	(49.9)	112.0
16	**FEPO Days**	0.0	68.3	68.3	(49.8)	18.5	18.5	0.0
17	**FLR (%)**	6.2	6.3	12.5	11.7	24.2	18.0	6.2
18	**FLR Days Equivalent**	83.0	73.4	156.4	176.8	333.2	249.4	83.8
	Totals							
19	**Unit Capability Factor (%)**	86.3	(8.9)	77.5	6.4	83.8	(4.9)	88.7
20	**PO Days**	318.2	13.0	331.2	(200.0)	131.2	(122.9)	254.1
21	**FEPO Days**	0.0	131.2	131.2	(111.5)	19.7	19.7	0.0
22	**FLR (%)**	5.4	6.3	11.7	0.6	12.3	7.2	5.1
23	**FLR Days Equivalent**	180.5	290.7	471.2	74.9	546.1	344.7	201.4
24	**Subtotal TWh**	49.9	(5.6)	44.2	3.9	48.2	(3.3)	51.4
25	**Forecast for Major Unforeseen Events**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	**Total TWh**	49.9	(5.6)	44.2	3.9	48.2	(3.3)	51.4

Numbers may not add due to rounding.

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Exhibit E2
Tab 1
Schedule 2
Table 1b

Table 1b
Comparison of Production Forecast - Nuclear

Line No.	Prescribed Facility	2008 Actual	(c)-(a) Change	2009 Actual	(c)-(e) Change	2009 Budget
		(a)	(b)	(c)	(d)	(e)
	Darlington NGS					
1	**TWh**	28.9	(2.9)	26.0	(0.5)	26.6
2	**Unit Capability Factor (%)**	94.5	(8.6)	85.9	(0.5)	86.5
3	**PO Days**	69.1	101.2	170.3	(1.4)	171.7
4	**FEPO Days**	0.0	11.9	11.9	11.9	0.0
5	**FLR (%)**	0.7	0.9	1.6	(0.4)	2.0
6	**FLR Days Equivalent**	9.9	11.0	20.9	(4.9)	25.8
	Pickering A NGS					
7	**TWh**	6.4	(0.7)	5.7	(1.6)	7.3
8	**Unit Capability Factor (%)**	71.8	(7.6)	64.2	(15.4)	79.5
9	**PO Days**	0.0	74.0	74.0	0.0	74.0
10	**FEPO Days**	1.1	31.4	32.5	32.5	0.0
11	**FLR (%)**	27.9	(3.3)	24.6	13.1	11.5
12	**FLR Days Equivalent**	203.1	(50.5)	152.6	77.2	75.4
	Pickering B NGS					
13	**TWh**	12.9	2.2	15.1	(1.0)	16.0
14	**Unit Capability Factor (%)**	71.4	12.6	84.0	(3.2)	87.2
15	**PO Days**	62.1	63.4	125.5	23.5	102.0
16	**FEPO Days**	18.5	9.2	27.7	27.7	0.0
17	**FLR (%)**	24.2	(18.3)	5.8	(0.4)	6.2
18	**FLR Days Equivalent**	333.2	(257.3)	75.9	(8.3)	84.2
	Totals					
19	**Unit Capability Factor (%)**	83.8	(1.9)	82.0	(3.7)	85.6
20	**PO Days**	131.2	238.6	369.8	22.1	347.7
21	**FEPO Days**	19.7	52.4	72.1	72.1	0.0
22	**FLR (%)**	12.3	(5.8)	6.4	1.6	4.8
23	**FLR Days Equivalent**	546.1	(296.7)	249.4	64.0	185.4
24	**Total TWh**	48.2	(1.4)	46.8	(3.1)	49.9
25	**Forecast for Major Unforeseen Events**	0.0	0.0	0.0	0.0	0.0
26	**Total TWh**	48.2	(1.4)	46.8	(3.1)	49.9

Numbers may not add due to rounding.

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Exhibit E2
Tab 1
Schedule 2
Table 1c

Table 1c
Comparison of Production Forecast - Nuclear

Line No.	Prescribed Facility	2009 Actual	(c)-(a) Change	2010 Budget	(e)-(c) Change	2011 Plan	(g)-(e) Change	2012 Plan
		(a)	(b)	(c)	(d)	(e)	(f)	(g)
	Darlington NGS							
1	**TWh**	26.0	1.8	27.8	1.1	28.9	0.1	29.0
2	**Unit Capability Factor (%)**	85.9	4.4	90.3	3.6	93.9	0.2	94.1
3	**PO Days**	170.3	(51.5)	118.8	(50.5)	68.3	(2.8)	65.5
4	**FEPO Days**	11.9	(11.9)	0.0	0.0	0.0	0.0	0.0
5	**FLR (%)**	1.6	0.1	1.7	(0.2)	1.5	0.0	1.5
6	**FLR Days Equivalent**	20.9	1.6	22.5	(1.6)	20.9	0.1	21.0
	Pickering A NGS							
7	**TWh**	5.7	0.9	6.6	0.8	7.4	0.3	7.7
8	**Unit Capability Factor (%)**	64.2	9.5	73.7	8.9	82.6	2.7	85.3
9	**PO Days**	74.0	71.0	145.0	(63.0)	82.0	(7.0)	75.0
10	**FEPO Days**	32.5	(32.5)	0.0	0.0	0.0	0.0	0.0
11	**FLR (%)**	24.6	(16.6)	8.0	(1.0)	7.0	(2.0)	5.0
12	**FLR Days Equivalent**	152.6	(105.8)	46.8	(1.4)	45.4	(12.5)	32.9
	Pickering B NGS							
13	**TWh**	15.1	(1.4)	13.7	0.9	14.6	0.7	15.3
14	**Unit Capability Factor (%)**	84.0	(7.9)	76.1	4.9	81.0	3.7	84.7
15	**PO Days**	125.5	165.5	291.0	(69.0)	222.0	(50.0)	172.0
16	**FEPO Days**	27.7	(27.7)	0.0	0.0	0.0	0.0	0.0
17	**FLR (%)**	5.8	(0.8)	5.0	(0.5)	4.5	(0.5)	4.0
18	**FLR Days Equivalent**	75.9	(17.4)	58.5	(2.8)	55.7	(4.0)	51.7
	Totals							
19	**Unit Capability Factor (%)**	82.0	1.3	83.3	4.8	88.1	1.7	89.8
20	**PO Days**	369.8	185.0	554.8	(182.5)	372.3	(59.8)	312.5
21	**FEPO Days**	72.1	(72.1)	0.0	0.0	0.0	0.0	0.0
22	**FLR (%)**	6.4	(2.9)	3.5	(0.3)	3.2	(0.4)	2.8
23	**FLR Days Equivalent**	249.4	(121.6)	127.8	(5.8)	122.0	(16.4)	105.6
24	**Total TWh**	46.8	1.4	48.2	2.7	50.9	1.1	52.0
25	**Forecast for Major Unforeseen Events**	0.0	(2.0)	(2.0)	0.0	(2.0)	0.0	(2.0)
26	**Total TWh**	46.8	(0.6)	46.2	2.7	48.9	1.1	50.0

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Tab 1
Schedule 1
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PRODUCTION FORECAST AND METHODOLOGY – NUCLEAR

1.0 PURPOSE

This evidence provides a description of the methodology used to forecast nuclear production, and presents the nuclear production forecast for 2011 - 2012.

2.0 OVERVIEW

OPG is seeking approval of a production forecast of 98.9 TWh for the 2011 - 2012 test period for the nuclear facilities, which is an improvement of 3.9 TWh over the actual production achieved during 2008 - 2009.

OPG operates its nuclear generating stations in compliance with all applicable regulations, requisite licences and approvals in a safe, efficient, and cost effective manner. OPG, in accordance with its Nuclear Safety Policy, conservatively implements unit shutdowns in all circumstances when, in OPG's assessment, the safe operation of the station could be at risk.

Section 3.0 provides a description of the nuclear production planning process which produces an integrated nuclear outage and generation plan ("Integrated Plan"). Section 4.0 presents the nuclear production forecast trend for 2007 - 2012 and describes the key factors impacting each year's production forecast.

During the test period, OPG forecasts improved production performance across its entire nuclear fleet, as a result of a reduction in the number of planned outage days and improvements in forced loss rate ("FLR") at Pickering A and B.

3.0 NUCLEAR PRODUCTION PLANNING PROCESS

3.1 Integrated Nuclear Outage and Generation Plan

Through the nuclear production planning process, OPG seeks to establish accurate and reliable annual production forecasts for its individual nuclear units and an aggregated forecast for each station. Nuclear facilities are designed as base load generators; meaning

in the draft Integrated Plan. This review identifies revisions to the generation plan to reflect the latest generation-related information from across Nuclear or any changes in the overall nuclear program direction. The final Integrated Plan is incorporated into OPG's overall business planning process. Once approved through the OPG business planning process, the Integrated Plan will not change until the completion of the subsequent business planning cycle.

3.5 Forecast for Major Unforeseen Events

On average from 2005 - 2008, OPG's actual nuclear production has been less than the approved nuclear business plan forecast by approximately 3.5 TWh. An analysis of these production shortfalls revealed that they were largely the result of Nuclear's experience with forced outages and forced extensions to planned outages due to major unforeseen events. Accordingly, OPG has adjusted its production forecast methodology in the 2010 - 2014 Business Plan to include a 2.0 TWh per year allowance for major unforeseen events on the expectation that these types of events will occur in the future. (see Attachment 4 for analysis).

The Nuclear business unit strives to maximize nuclear production while ensuring safe and reliable operations. In order to incent and challenge the nuclear organization, OPG has established a stretch performance target that is 2.0 TWh higher than the 2010 - 2014 Business Plan production forecast. The performance of OPG Nuclear's management will be assessed in part against its ability to achieve this stretch target (including payouts under the Annual Incentive Plan).

4.0 OPG NUCLEAR PRODUCTION FORECAST TREND

The expected trend in nuclear production starting from 2007 is for production to decline over the period 2008 - 2010 followed by an increase in 2011 and a further increase in 2012. This data is provided in Ex. E2-T1-S1 Table 1.

The major factors influencing the trend in production over 2007 - 2012 are:

ATTACHMENT 2
OPG NUCLEAR INITIATIVES TO IMPROVE OUTAGE AND PRODUCTION PERFORMANCE

Since 2004, OPG Nuclear has instituted a series of programs to invest in aspects of its operations, including: i) improving the material condition of its nuclear assets, and ii) improving outage planning procedures and processes to increase productivity and reduce outage duration.

Since 2006, the success of the improved plant material condition and improved outage planning procedures and processes initiatives is beginning to emerge. As noted by ScottMadden in the 2009 Benchmarking Phase 1 report, Darlington's forced loss rate ("FLR") was within the best quartile (Ex F5-T1-S1 page 86). Positive results also emerged in 2009 for Pickering B, with the successful completion of the Unit 6 fall outage ahead of schedule. The actual FLR for Pickering B in 2009 was 5.8 per cent as compared to the two-year trend of 12.5 per cent in 2007 and 24.2 per cent in 2008. At Pickering A, Unit 1 achieved best quartile performance with a UCF of 91.4 per cent in 2009, an improvement compared to 39.0 per cent in 2007 and 62.3 per cent in 2008. The Unit Capacity Factor ("UCF") best quartile benchmark is 91.0 per cent (see Ex F5-T1-S1). Pickering A Unit 1's FLR in 2009 was 8.1 per cent which is an improvement from the two-year trend of 50.8 per cent in 2007 and 37.2 per cent in 2008.

The following provides additional details on past and future initiatives to improve outage and production performance:

i) Improving the Material Condition of the Nuclear Units

Improving the material condition of the nuclear units is expected to improve the long-term performance and reliability of OPG's nuclear generating stations. Investments are focused on completing life cycle programs for major components such as feeder replacement, steam generator inspections, and the completion of the Spacer Location and Relocation program ("SLAR"). Another initiative relates to the plant reliability list program. The plant reliability list is a comprehensive, prioritized list of critical work orders based on system and component

health assessments. The plant reliability list integrates a number of initiatives into one plan where previously such initiatives had been managed separately. This allows OPG Nuclear to focus on the highest priority, most critical work. The execution of the plant reliability list program, which is continuous and ongoing, is expected to result in improved system health, plant material condition, and improved plant reliability.

At Darlington, the focus is on completing life cycle programs for major components such as feeder replacements. At Pickering B, the focus is on completing major life cycle programs including the completion of the SLAR program. At Pickering A, the focus since 2005 has been on the return to service of its units after their extended shut-down. Starting in 2009, Pickering A introduced the Pickering A Equipment Reliability program. The objective of this program is to restore Pickering A's plant performance to the historically achieved levels, reduce forced losses and improve generation performance. Discussion of the Pickering A Equipment Reliability program is found at Ex F2-T2-S1 Attachment 2.

OPG's efforts to maintain and improve the material condition of its plants are also focused on reducing the number of corrective and elective maintenance backlogs at all three stations. Maintenance backlogs represent deficiencies at the plant and are an indicator of station health. Prior to 2004, OPG reduced its investment in reducing maintenance backlogs. Moving forward, OPG is refocusing its resources on elective and corrective maintenance programs to reduce backlogs and improve station health, thereby improving reliability and reducing the potential for forced production losses.

CHART 1
Elective and Corrective Backlogs - 2005-2012

Station	Backlog Description	2005 Actual	2006 Actual	2007 Actual	2008 Actual	2009 Actual	2010 Budget	2011 Plan	2012 Plan
Pickering A	Elective	541	558	428	420	333	350	335	320
	Corrective	8	17	14	17	11	10	10	10
Pickering B	Elective	805	885	926	681	554	500	425	400
	Corrective	148	71	22	24	20	25	20	20
Darlington	Elective	767	584	373	313	279	275	250	235
	Corrective	20	14	13	8	7	9	8	7
OPG	Elective	737	699	605	482	400	380	337	318
	Corrective	69	37	17	16	13	16	13	13

As reported in the Phase 1 Benchmarking Report, all three OPG stations are worse than median for both elective and corrective maintenance backlogs compared to North American peers. As part of the gap-based target setting process introduced as part of the Phase 2 Nuclear Benchmarking Initiative (Ex F2-T1-S1), five-year elective and corrective backlog targets were set to narrow this performance gap by reducing the level of elective backlogs at all three sites, and stabilizing the level of corrective backlogs at Pickering.

ii) Outage Planning Procedures and Processes - Station Led Initiatives

OPG's nuclear stations have undertaken steps since 2006 to introduce robust outage planning procedures and processes designed to improve outage performance. These initiatives include:

- Improving Outage Planning: OPG Nuclear is planning for shorter duration, "routine" planned outages, supported by the following initiatives:
  - Implementing improved industry-standard outage planning milestones in the planned outage process, to transition to industry best practices. Improving processes to better manage outage scope so as to reduce the number of planned outage days.
  - Establishing standard outage templates. Internal benchmarks detailing the amount of time and resources required for "routine" outage work activities. Implementing the recommendations from "lessons learned" reviews following planned outages.
- Improving Outage Execution: Improve outage execution performance to reduce outage duration and costs including the following steps:
  - Creating an Outage Control Centre: Using industry best practices, OPG centralized the oversight and project management of outage execution at each site into an Outage Control Centre in 2006. The centre is staffed with senior line management who have the authority to make the immediate decisions necessary to keep outages on schedule.
  - Developing Specialized Teams: As noted above, outage scope consists of routine and non-routine work activities. OPG has recently initiated a process to create specialized work teams and provide them with advanced preparation and training.
  - Co-ordination of Operations and Maintenance: Operations staff performs activities associated with preparing and placing systems and components in-service and out of

service for maintenance, while maintenance staff perform all activities directly related to the preventative, elective, and corrective maintenance. Consequently, maintenance staff cannot initiate maintenance activity until operations staff had completed their work. Recent initiatives have been directed at improving co-ordination between operations and maintenance staff as well as allocating more operations staff to support the outage thereby increasing productivity and reducing inefficiencies.

- Improving Forced Outage Readiness: OPG has reviewed and adopted best industry practices related to forced outage management readiness to quickly respond to, and more effectively manage, forced outages.
- Improving Material Availability: OPG is seeking to minimize delays in the completion of outages by ensuring materials and replacement parts are available as required. Nuclear Supply Chain is focusing on reducing the average cycle time required to deliver materials and replacement parts to the stations.

iii) Outage Planning Procedures and Processes – Fleet-wide Initiatives

With the benefits from the outage improvement initiatives at the station level emerging since 2006, OPG believes that additional improvements in outage performance and costs can be obtained by moving towards an integrated, fleet-wide approach. Outage planning and execution are station accountabilities. As a result, past outage improvement initiatives were generally implemented separately by each station. OPG uses peer teams composed of representatives from each station to provide a forum for the sharing and implementation of best practices.

During Phase 2 of the 2009 Benchmarking Initiative, a new fleet-wide initiative ("Outage Improvement Strategy") was identified as one of seven top priorities for implementation. The Outage Improvement Strategy represents the consolidation of various actions to improve outage execution and planning and it will be implemented through an integrated fleet approach. The objective is to develop an integrated Outage Improvement Plan that looks at the performance gaps across the fleet and addresses key drivers and program changes on a fleet-wide basis, necessary to drive improved outage performance and lower cost. This approach is similar to the process used successfully by Exelon Corporation, which operates the largest fleet of nuclear stations in the United States.

The Outage Improvement Strategy that was developed during the 2009 Phase 2 Benchmarking is comprised of the following sub-initiatives:

- Improve Contractor Management Process
- Improve Outage Scoping Process
- Implement Outage Duration Improvement Program
- Standardize Outage Control Centre across fleet
- Formalize Continuous Fleet Outage Improvement Program
- Outage Training Performance Improvement Initiative
- Execution Rate Improvement Plan

The Outage Improvement Strategy builds upon past work at the sites to introduce optimal fleet-wide processes and procedures. OPG will focus on improving fleet contractor management procedures (how work is managed, what work is performed, when the work is scheduled, what support is available), improving contractor productivity/efficiency by increasing the amount of work done each day. Other key areas targeted are the scoping process where OPG is committed to improving the timely identification and assessment of the planned outage work prior to the scope freeze milestone date. Improving OPG's ability to pre-plan and assess the level of work and resources required will avoid delays in execution of the outage and/or higher costs. Another component of the Outage Improvement Strategy is to review and implement fleet-wide standards for minimum staffing requirements based on best in fleet organizational practices.

Another separate initiative aimed at improving outage planning and processes is the roll-out of the Primavera P6 software planning tool. Primavera P6 is a construction project management product created for prioritizing, planning, scheduling, managing and executing projects. Primavera P6 enhances OPG's ability to model and optimize resource usage for outage execution on a fleet-wide basis, thereby increasing outage productivity and reducing outage duration.

Numbers may not add due to rounding.

Table 1
Production Forecast Trend - Nuclear (TWh)

Line No.	Prescribed Facility	2007 Actual	2008 Actual	2009 Actual	2010 Budget	2011 Plan	2012 Plan
		(a)	(b)	(c)	(d)	(e)	(f)
1	**Darlington NGS**	27.2	28.9	26.0	27.8	28.9	29.0
2	**Pickering A NGS**	3.6	6.4	5.7	6.6	7.4	7.7
3	**Pickering B NGS**	13.4	12.9	15.1	13.7	14.6	15.3
4	**Forecast for Major Unforeseen Events**	0.0	0.0	0.0	(2.0)	(2.0)	(2.0)
5	**Total**	44.2	48.2	46.8	46.2	48.9	50.0

PRODUCTION FORECAST AND METHODOLOGY - NUCLEAR

1.0 PURPOSE

The purpose of this evidence is to provide a description of the methodology used to forecast nuclear production, and present the nuclear production forecast from 2005 - 2009.

Section 2.0 provides a description of the three phased Nuclear Production Planning Process which produces an integrated nuclear outage and generation plan ("Integrated Plan"). Section 3.0 presents the nuclear production forecast for 2005 - 2009 and describes the key factors impacting each year's production forecast. Section 4 discusses past and current initiatives at OPG that are addressing production reliability and outage performance. Definitions of terms italized below can be found in page 19.

2.0 NUCLEAR PRODUCTION PLANNING PROCESS

2.1 Overview – Integrated Nuclear Outage and Generation Plan

Production from a nuclear facility in a given year is equal to the sum of the station units' capacity in terawatt ("TW") times the number of hours in a year, less the number of hours during which the facility is subject to either planned outages or forced production losses. Nuclear facilities are designed as base load generators meaning generator output does not vary with market demand.

The OPG Nuclear production planning process produces an Integrated Plan. For each station, the plan derives a planned outage schedule and an estimate of *forced production losses*, due to unplanned outages and *derates.* OPG is a member of the *World Association of Nuclear Operators* ("WANO") and as such uses the WANO performance indicators to plan, track and assess the performance of OPG Nuclear units. For the purpose of this evidence, *forced production losses* and *planned outages* are defined in the Glossary of Terms as per the *WANO* industry guidelines. The discussion on standard industry benchmarks found in Ex. A1-T4-S3 describes the most common indicators used to plan and track OPG Nuclear performance.

The objectives of the Integrated Plan process include:

- Providing a key input into the annual OPG business planning process.
- Ensuring availability and optimal deployment of internal resources and external resources as needed to execute inspection, modification, and maintenance programs.
- Providing long-term operational plans to allow coordination of nuclear outages across OPG Nuclear, so as to plan reactor outages to occur in periods which have minimal impact on the Ontario electrical grid.
- Complying with the IESO market rules by providing the IESO with information on OPG's nuclear production, capacity, and reliability assumptions.

The following outage scheduling guidelines are considered during the planning process:

1. Eliminate/minimize overlap of planned outages in the Integrated Plan.
2. Minimize scheduling of planned outages during peak seasonal periods including summer and winter seasons.
3. Ensure outage changes impact minimally on planned production targets.
4. Proactively minimize probability of inter-site work and schedule conflicts re: shared resources and tooling (e.g. inspection maintenance services campaigns and *feeder* replacement projects; optimize use of roving maintenance crews).
5. Ensure standard intervals are applied between planned outages at each unit.

The Integrated Plan is generated annually in parallel with business planning and produces the following deliverables:

- A five year planned outage schedule for all stations. The schedule includes unit outage start dates, end dates, and durations.
- A summary of major elements of the work scope to be executed during each outage, with a higher level of specificity for scope elements occurring in outages during the first two years of the Integrated Plan.
- Operational reliability performance targets such as *unit capability factor* and the level of forced production losses represented by the *forced loss rate* ("FLR"). Discussion on such performance targets can be found at Ex. A1-T4-S3.

- Annual generation forecasts, in terawatt-hours ("TWh"), for individual nuclear units and an aggregated forecast for each station.

2.2 Generation Planning Methodology

The outage and generation planning process mandates three formal planning and review sessions per year which culminate in a final Integrated Plan:

- Phase 1: In the spring, based on a review of the previous five-year Integrated Plan, changes are projected and a first draft of the new Integrated Plan is produced. The first draft of the Integrated Plan is an input in the Nuclear business planning process.
- Phase 2: In the summer, a revised second draft of the Integrated Plan is produced. The second draft is incorporated into the initial nuclear submission to the OPG business planning process.
- Phase 3: In the fall, outage and nuclear generation forecasts are reviewed and finalized for the next five years in the final Integrated Plan for that year which is incorporated into the final nuclear submission to the OPG business planning process.

In addition, reviews are conducted on an ongoing basis to identify, assess and quantify any emergent developments and planning assumption changes that may impact a station generation plan. Outage and generation changes are incorporated into the draft Integrated Plan as updates occur over the three planning and review sessions during the year. Non-routine meetings are also conducted, in addition to the three mandated planning sessions, when developments in program assumptions or outage schedules need to be addressed. On limited occasions, significant developments may necessitate adjustments to the current approved Integrated Plan, if they impact on the immediate two year outage planning horizon. Examples of significant developments would include:

- *Lesson learned review* analysis from recent OPG outages, internal operating experience, emergent discovery work, or short-term updates to *life cycle management programs*.
- Operating experience incorporated from others in the nuclear industry.
- Unanticipated regulatory orders/decisions/requirements (e.g., Canadian Nuclear Safety Commission, Technical Standard and Safety Authority), or a failure to obtain regulatory

concurrence for plans, such that OPG must proceed with work activities which it had anticipated would not be required.

The draft Integrated Plan, and all non-routine updates to the current approved plan are approved by the Chief Nuclear Officer.

The following describes the stages in the preparation of the draft Integrated Plan.

2.2.1 Phase 1: Station Submission and Outlook

Generation planning begins at the start of the year with each station submitting an initial outage outlook for the five-year period commencing January of the next calendar year. For example, the station's generation planning review during 2006 covered the 2007 - 2011 timeframe. The process consists of a review and an update of years two to five of the currently approved five-year Integrated Plan. Outages for the first two years (year one in particular) of the five year planning cycle are subject to the most extensive review and planning. Outage details and generation data are also added for one additional year beyond the five years covered by the currently approved Integrated Plan.

The update process ensures that any regulatory, operational or maintenance issues that have arisen since the last Integrated Plan was finalized are reflected in the new Integrated Plan. Often outage durations are amended to include life cycle plan adjustments to inspections or maintenance needed to preserve the asset, or for disposition of regulatory concerns that have been identified through analysis of data obtained from recent outages experienced at either OPG or other nuclear industry participants. Major adjustments to the first year of the Integrated Plan are less likely than adjustments to subsequent years because the first year of the outage plan would have been subject to repeated reviews and updates over previous planning cycles. The deliverables in phase 1 are:

1. A five-year planned outage schedule for each unit in the nuclear fleet, as described below.
2. Targeted levels for forced production losses, as described below.

3. Generation targets and the underlying rationale for the changes relative to the currently approved Integrated Plan.

Planned Outage Schedule

Outage scope and duration for a planned outage are primarily determined by the station's life cycle plan (as discussed below), which includes the inspections and maintenance necessary to ensure safe, reliable long-term operation and regulatory requirements. With regard to the scope of regulatory requirements, the nuclear industry stands apart from other regulated industries and other forms of electrical generation due to the complex nature of its technology, the criticality of safety in operations and the nature of nuclear regulations. Consequently, the key drivers associated with OPG's nuclear operations (i.e., safety, complexity, training, material standards, work environment, non-standard fleet, aging technology, evolving regulatory standards, and achievements in technology) that are outlined with respect to base OM&A in Ex. F2-T2-S1 are equally applicable and impact outage scope, duration, and cost.

Outage periods involve many plant organizations and individuals working together, and as such require high levels of coordination. Indeed, outages require focus, expertise, and a level of detail, which exceeds that of a major construction project. Careful preparation and execution of a well-developed plan are necessary for nuclear, radiological, and industrial safety as well as efficient achievement of production goals.

Outages consist of a combination of "routine" inspection and maintenance activities generally repeated for any outage, plus "non-routine" activities specific to a particular outage, all of which involve thousands of work tasks, representing extensive person-hours of labour, logically sequenced in the optimal order to ensure safe and effective execution of the outage. As an example of the complexity of outage planning, attached in Appendix A are level 1 schedules for the Pickering B Unit 6 2007 planned outage and the Darlington Unit 4 2007 planned outage.

Examples of routine activities would be *preventive maintenance programs*, *feeder* inspections or water lancing of *steam generators*, to maintain performance and reliability. Non-routine activities could include changes, upgrades, replacements or modifications to the equipment or plant configuration that can only be done when the unit is shut down, such as single fuel channel replacement or low level drain state.

Even though OPG intends to transition to standard baseline outage templates, any outage will have unique aspects based on specific outage scope. Approximately 60 percent of the work activities in an outage scope typically relate to routine preventative maintenance and inspection activities while the remaining 40 percent relate to work activities for non-routine upgrades and modifications. Within this split, the station's planned outage scope would primarily consist of pre-defined work activities and related work tasks. However, approximately 15 percent of planned outage scope is contingency work activities anticipated to arise from *discovery work* during the routine inspection and preventive maintenance activities. These contingency activities are carefully selected based on risk assessments and historical experience. This approach allows OPG to proactively plan for, and be in a position to quickly respond to such discovery work as it is identified over the course of the outage. Including contingency work activities within planned outage scope minimizes potential disruption to the outage schedule due to *critical path and bulk work* delays, as well as improving the credibility of the Integrated Plan.

In addition, in order to avoid a significant disruption to the outage schedule, OPG may have to postpone completion of non-critical, non-safety related discovery work activities until a following outage. This decision to postpone work activities can lead however to reduced production reliability during the post-outage period and require that future planned outages include deferred items from previous outages. By providing for a prudent level of contingency work activity in planned outage scope, OPG can balance the risk of outage extension due to discovery work against post-outage production reliability.

Outage duration is determined by the *critical path* of outage inspections and maintenance. It is also impacted by the configuration of the generating unit required to support complex

logistical requirements of outage activities and the availability of the mandatory minimum equipment required for protection of the reactor fuel. Historically, the bulk of the outage critical path duration has been based on *fuel channel and steam generator* work. Recently feeder piping inspections and maintenance are emerging as an additional critical path driver at some units.

The following steps outline the process that yields each station's planned outage schedule:

- Each station identifies the inspection and maintenance activities required to comply with the long-term objectives of the aging and life cycle management programs, and to ensure safe and reliable operation of OPG Nuclear facilities for the duration of their planned lives. The aging and life cycle management programs outline specific objectives for all of the major plant components (e.g., *fuel channels*, *steam generators, feeders*). The program also details the frequency and nature of inspections, and recurring preventive maintenance work required to ensure unit fitness for service and maintain reliability and safety of the plant. While outage scope will always include routine inspections and maintenance activities, the equipment affected will vary from one outage to the next, in accordance with the inspections and maintenance schedule specified in the integrated aging and life cycle management programs. Variation in the scope of outages comes from corrective maintenance, projects and other non-routine activities. These variations are required to respond to issues specific to a station or to a unit(s) within a station, as units do not necessarily age according to the same pattern or at the same rate. The *critical path* of an outage can be impacted by these variations.
- OPG's nuclear operating licenses issued by the Canadian Nuclear Safety Commission (further described in Ex. A1-T6-S1) require that a number of tests and maintenance activities be performed at specified intervals, to ensure continued safety. In some instances, the requirement necessitates the shut down of all the units within the station, because the test or the work involves a common safety system or component (e.g., vacuum building outage at Pickering and station containment outage at Darlington).
- The stations develop high level planned outage schedules with the input and joint effort of several organizations, including Engineering, Inspection Maintenance Services, and Projects and Modifications. To accommodate constraints around inter-site sharing of

certain resources and tooling, this integrated input is a significant factor in determining both the scheduled outage dates and the sequencing of major critical path activities to ensure effective deployment of inspection and maintenance resources between the units on outage, particularly in those instances where overlapping multi-site outages occur. For example: Inspection Maintenance Services staff will review the planning outage schedule to ensure that, given available resources, the scoped activities are executed and coordinated across all OPG stations, as well as providing additional review to ensure Inspection Maintenance Services external commitments are met. This is critical due to the limited availability of highly specialized nuclear tooling and personnel. Efforts are also made to schedule outages at different sites sequentially to facilitate the sharing of operations and maintenance resources. As well, the planned outage schedule is reviewed to identify and resolve potential conflicts between stations in use of shared specialty resources such as project crews, contract staff, and major component spares such as turbine spindles or *feeder* replacement tooling.

- At this stage of planning, the outage OM&A costs are also estimated based on several factors including historical experience, projected contractor's costs, parts and projected equipment costs, and staffing requirements. Further discussion about the components and derivation of the forecasted outage OM&A costs can be found at Ex. F2-T4-S1.

Station staff prepares resource, duration, and cost estimates at a detailed level for outages. The analysis is more detailed for the initial years of the Integrated Plan. This analysis allows the stations to prioritize work activities and examine the economic justification for necessary but non-essential activities, relative to other competing needs.

The outage schedules involve development of detailed logic diagrams that identify start and end dates for individual activities within each outage. The *critical path* for upcoming outages is also determined at this level of planning.

- Each station's planned outage schedule includes some allowance for uncertainty to outage duration although the amount of allowance for uncertainty is not mandated nor standardized across all OPG stations, or even within the same station from one outage to

the next. The station allowance for uncertainty to outage duration is reflected in the derivation of the *critical path* that underpins the planned outage duration and will reflect a station assessment of such factors as knowledge gained from past outages, assessment of the known and unknown technological risks specific to the outage, the number of inspections that may result in *discovery work* and resource capability and availability.

Forced Production Losses

With respect to *forced production losses*, all generating units face the risk of unscheduled equipment problems that may require unplanned shutdowns or derating the generating units. Accordingly, the stations develop targets that reflect the risk of such *forced production losses* for all units in the station. For planning purposes, the targets are derived as a forecast FLR.

Force loss rate target assumptions are determined by station management with input from Outage and Strategic Planning Departments, Engineering, and Finance. The FLR target assumptions incorporate the plants' recent historical performance, any known improvements or deterioration in plant material condition, past and future investment in reducing corrective and elective maintenance backlogs to improve reliability, and known risks. Further discussion on FLR target assumptions can be found at section 3 (OPG Nuclear production forecast trend) below.

Initial Draft Integrated Outage and Generation Plan

Using each station's initial planned outage schedule and FLR target assumptions, the Nuclear Finance Business Planning group prepares a draft Integrated Plan. The draft Integrated Plan provides outage schedules and targeted *forced production losses* for each station and for the entire OPG fleet, and is an input to the Nuclear business planning process.

The Nuclear Finance Business Planning group uses a generation planning model to calculate generation production targets (TWh) for each station. The model generates production and reliability targets using two independent variables: the number of planned

outage days and the FLR target assumption. The model generates unit specific targets, as well as station and Nuclear fleet level summaries.

The draft Integrated Plan prepared by the Nuclear Finance Business Planning group provides monthly and annual generation TWh targets, planned outage days, and corresponding generation performance indicators including unit capability factor at the unit, station and fleet level, for each of the five years of the Integrated Plan.

2.3 Phase(s) Two and Three: Final Integrated Outage and Generation Plan

Following the preparation of the spring draft Integrated Plan, two subsequent Integrated Plans are prepared in the summer and fall as part of the three step planning process. The summer and fall updates follow up on phase one by responding to the latest generation related information from across OPG Nuclear and any changes in the overall nuclear program direction. The station outage schedules and station FLR target assumptions developed in phase one are reviewed for achievability and the economic rationale by station management, the Chief Nuclear Officer, and the Nuclear Executive Committee as part of the business planning process. These reviews can potentially identify revisions necessary to maintain the Integrated Plan in alignment with the business plan objectives, while ensuring the nuclear mandate of safe and reliable long-term operation is also maintained. The summer review (phase two) yields a preliminary set of nuclear generation targets which are incorporated into the five-year Nuclear business plan in October. The purpose of the October review (phase three) is to allow for corporate finalization, and approval in December of the final Integrated Plan in support of the final OPG business plan. The reviews also incorporate the fleet level uncertainty adjustment as discussed below.

The outage planning process also requires communication with OPG Energy Markets throughout the process and that their feedback is taken into account to:

1. Increase the probability of the proposed schedule being approved by the IESO, based on anticipated (i.e., 18 month forward looking) provincial supply and demand at the time of the proposed outage.

2. Take mitigating actions where the probability of obtaining IESO outage approval is at risk (e.g., re-schedule other OPG non nuclear outages).

Planned outages must be registered with and "date-stamped" by the IESO. OPG Energy Markets files the OPG Nuclear outage schedule for the coming 18 months (and beyond) in order that OPG's outages secure an early "time-stamp" date, which determines their standing in the IESO's outage queue. All outages in the queue are subject to final approval by IESO, which can deny final approval of any planned outage at any time up to the start of the outage.

Fleet Level Uncertainty Adjustment

OPG incorporates a Nuclear fleet adjustment to the challenging station targets to arrive at a likely forecast of output from the overall Nuclear fleet. This fleet level uncertainty adjustment is a prudent way to manage fleet production forecasts. This adjustment is applied by nuclear management following the submission of the station production targets. This adjustment, which is typically 0.5 TWh (or one percent of forecast production), is intended to bring the fleet level production forecast to within acceptable confidence limits.

This adjustment for uncertainty is intended to address generic planned outage issues of the fleet. This differs from station planning where the prime focus is on risk assessment of a specific unit planned outage. The fleet adjustment recognizes the potential for concurrent or unexpected events not predictable from a station unit perspective in a given year. The fleet assessment is intended to mitigate threats that could emanate from general fleet aging issues, complexity in the fleet level activities (e.g., traveling crews and Inspection and Maintenance Services) in support of outages.

The fleet level uncertainty assessment is based on past experience, and recognizes the potential for unexpected additional inspections or maintenance that could impact the duration of a planned outage or the potential for forced outages within the fleet. The fleet adjustment which results from this assessment is formalized by applying adjustments to the planned outage duration for each station's planned outage schedule. The adjustment reflects the

probability that there will be some major scope additions or delays resulting in an extension of a planned outage for at least one of OPG's nuclear units during the period. The fleet allowance reflects the integration of OPG's nuclear fleet and is not the sum of discrete outage by outage adjustments.

Over the past several years, actual lost production due to concurrent or unexpected events has exceeded the budgeted adjustment level provision. However, the fleet level uncertainty adjustment was not increased in the test period but remains in the typical 0.5 TWh range. This is because of expectations that the number of initiatives undertaken or that are being implemented, as discussed in section 4.0 below, will improve outage performance and reduce the factors that have compromised our forecast certainty in the past as well as maintaining the incentive for fleet operations to achieve a challenging production target.

3.0 OPG NUCLEAR PRODUCTION FORECAST TREND

The nuclear production forecast for 2008 - 2009 is shown in Ex. E2-T1-S1 Table 1 based on the business plan approved in December 2007, along with comparable historic figures for the period 2005, 2006 and 2007.

As shown in Ex. E2-T1-S1 Table 1, the expected trend in nuclear production over the period 2005 - 2009, consistent with the Integrated Plan finalized as of December 2007, shows a gradual but steady improvement in generation output. In 2009, the slight reduction in output is due to the simultaneous four unit outage for routine vacuum building inspection at Darlington.

The improving trend in nuclear production post 2005 reflects in part that prior to 2005, OPG Nuclear instituted a series of programs to address a previous lack of investment in many aspects of its operations, including maintaining the plant material condition of its nuclear assets and the lack of robust outage planning procedures and processes. In 2003, it was determined that, while some improvements (primarily safety and human performance related and inspection results) had been achieved, concerns remained over OPG Nuclear's future

performance capabilities. The most significant risk identified was that the material condition of the nuclear plants was deteriorating as the plants entered the mid-points of their lives.

Since 2004, OPG Nuclear has focused on increased investment in the material condition of the units, through activities such as the Pickering B spacer location and relocation program, *feeder* replacements, and *steam generator* inspections. This investment was aimed at improving the long-term, performance, and reliability of the OPG nuclear generating stations.

The 2008 and 2009 test year forecasts take into account these past initiatives (e.g., investment in plant material condition) as well as other initiatives, discussed in section 4.0, which will lead to more sustainable, reliable, and predictable performance. Indeed, although 2007 annualized production did not meet target due to the unique events described in Ex. E2-T1-S2, recent positive results confirm the success of these initiatives including:

- The successful completion, five days shorter than the business plan target, of the 2007 spring Darlington Unit 4 planned outage. In addition, the duration of the 2007 fall Darlington Unit 2 planned outage was also less than the business plan target. This is the second successive outage where the site has met or bettered the target business plan outage duration.
- The Darlington Unit 3 unbudgeted planned outage, while outside the business plan, was pivotal in obtaining Canadian Nuclear Safety Commission regulatory approval for and successful pilot use of a previously unused reactor heat sink configuration. This reduced the mandatory outage duration by 11 days and promises significant potential benefits for future outages at Darlington.
- Improved organizational performance at Pickering B resulted in the completion of maintenance work activities during the maintenance window of the Pickering B Unit 5 planned spring outage on schedule and with the highest production task rate (work activities per outage day) ever achieved by Pickering B. However, the Unit 5 outage had to be extended due to equipment failures during the start-up window. Also the Pickering B fall outage was completed in 77 days, an improvement over previous outage performance of comparable scope which has required around 100 days.

For the 2008 - 2009 test period, the forecast number of planned outage days is 254 days in 2008 and 343 in 2009. This is a significant reduction from the 386 outage days (346 planned outage and 40 forced extension to a planned outage) experienced in 2005 and the 490 outage days (324 planned outage and 167 forced extension to a planned outage) experienced in 2006. Similarly, the FLR for the combined fleet of nuclear assets is expected to improve, with an anticipated drop from 11.7 percent in 2007, to a target of 4.2 percent by 2009. This improvement in the forecast FLR for the combined fleet in 2009 reflects the improved operating experience at Darlington and Pickering B which has allowed a reduction in the FLR target to 2 percent and 5 percent respectively offset by the ongoing reliability challenges at Pickering A reflected by an increased 2009 FLR target of 10 percent.

4.0 OPG NUCLEAR INITIATIVES TO IMPROVE OUTAGE PERFORMANCE AND PRODUCTION

OPG has implemented or is undertaking a number of initiatives to improve outage performance, the benefits of which are anticipated to emerge over time, including:

- Improving Outage Planning: Previous outage planning, particularly at Pickering B, was focused on major initiatives such as the spacer location and relocation program, resulting in "non-routine" outages typically longer than 100 days. OPG's expectation moving forward is that there will be shorter duration, "routine" planned outages, supported by the following initiatives:
  - Commencing in 2006, OPG began implementing improved industry-standard outage planning milestones in the planned outage process, to transition to industry best practices. Examples of the standard planning milestones are shown in Appendix B. The milestones are used to improve outage management by facilitating better outage planning. The milestones define and describe discrete deliverables, accountabilities, timeframes, due dates for completion, and the criteria to be used to verify completion of the deliverable. The revised process also establishes requirements for earlier identification of labour and material requirements in support of annual business planning and the Supply Chain initiative described below.

- Improving processes to better manage outage scope with the intent to reduce the number of planned outage days. Scope management initiatives include prioritization of the proposed outage activities by various criteria including cost justification and need, thereby ensuring that the highest priority activities are undertaken and deferring lower priority activities. Another scope management initiative is to reduce scope "churn" (i.e., adding or removing work activities after implementing scope freeze).
- Establishing outage templates. Internal benchmarks detailing the amount of time and resources required for "routine" outage work activities. This initiative will improve long-term outage planning as well as establish metrics for benchmarking outage performance.
- Implementing the recommendations from *lesson learned reviews* following *planned outages*.

• Improved Outage Execution: OPG has initiated steps to improve outage execution performance thereby reducing future outage duration and costs including:

- Outage Control Centre development. Using industry best practices, OPG centralized the oversight and project management of outage execution at each site into an Outage Control Centre in 2006. The centre is staffed with senior line management who have the authority to make the immediate decisions necessary to keep the outage on schedule.
- Specialized Teams: As noted above, outage scope consists of routine and non-routine work activities. OPG has recently initiated a process to create specialized work teams and provide them with advanced preparation and training. These teams manage specific non-routine work activities.
- Co-ordination of Operations and Maintenance: Operations staff perform activities associated with preparing and placing systems and components in-service and out of service for maintenance, while maintenance staff perform all activities directly related to the preventative, elective, and corrective maintenance. Consequently, maintenance staff cannot initiate maintenance activity until operations staff have completed their work. Recent initiatives have been directed at improving co-ordination between operations and maintenance staff as well as allocating more operations staff to support the outage thereby increasing productivity and reducing inefficiencies.

- Improving Forced Outage Readiness: OPG has reviewed and adopted best industry practices related to *forced outage* management readiness. The processes allow OPG to quickly respond to, and more effectively manage *forced outages.* OPG is also taking steps to improve the organizational focus on and adherence to such procedures, including completion of l*esson learned reviews* following *forced outages.*
- Reducing the Number of Outage Days: The current plant material condition at Darlington is allowing OPG to implement a three-year cycle for planned outages compared to the current two-year cycle. Under a two-year cycle plan, each unit would be subject to 80 outage days (a 56 day outage after 28 months and a 24 day outage after 18 months). Under the three-year cycle, each unit is to be subject to 51 day outage every 34 months, reducing the average outage days per year for the four Darlington units over the cycle from 80 to 68 days.
- Improving Material Availability: Project management of outages requires that materials and replacement parts are available as required to minimize delays in completion of the outage. As discussed at Ex. F2-T2-S1, Nuclear Supply Chain has implemented an initiative starting in 2005, which focuses on reducing the average cycle time required to deliver materials and replacement parts to the stations. Preliminary indications are that this initiative, in conjunction with the outage planning milestones described above, is improving work planning and material procurement resulting in improved performance.
- Improving Future Reliability By Reducing Maintenance Backlogs: This initiative is focused on efforts to reduce the number of corrective and elective maintenance backlogs at all three stations. Maintenance backlogs represent deficiencies at the plant and are used as an indicator of station health. In the past, as discussed at Ex. A1-T4-S3, OPG reduced its investment in reducing maintenance backlogs. Moving forward, OPG will be focusing its resources on elective and corrective maintenance programs to reduce backlogs and improve station health, thereby improving reliability and reducing the potential for forced production losses.

At Darlington and Pickering A, the focus is on reducing elective backlogs which are above industry standard benchmarks of 350 work orders per unit. The level of corrective backlogs is comparable with industry standards of 20 to 25 work orders per unit.

For Pickering B, initial focus has been on reducing corrective backlogs before major steps can be made to reduce the elective maintenance backlogs. In 2007 Pickering B was able to achieve its target of reducing corrective backlogs to industry standards.

CHART 1
ONLINE ELECTIVE AND CORRECTIVE MAINTENANCE BACKLOGS PER UNIT

Station	Backlog Description	2005 Actual	2006 Actual	2007 Actual	2008 Plan	2009 Plan
Pickering A	Elective	541	558	428	425	375
	Corrective	8	17	14	20	15
Pickering B	Elective	805	885	926	700	575
	Corrective	148	71	22	25	25
Darlington	Elective	767	584	373	350	325
	Corrective	20	14	13	15	15

- Improving the material condition of the plant: As noted above, during the period 2004 - 2007, OPG made major investments in improving the material condition of the Nuclear generating stations with the expectation of improved plant reliability and reduced forced production losses. This included investments to complete life cycle programs for major components at Pickering B and Darlington such as *feeder* replacement, *steam generator* inspections, and the completion of the spacer location and relocation program. Another initiative includes the plant reliability list program: The plant reliability list is a comprehensive identification and prioritization of critical work orders based on system and component health assessments. The plant reliability list integrates a number of initiatives into one plan where previously such initiatives had been managed separately across OPG Nuclear. This allows OPG Nuclear to focus on the highest priority, most critical work. The execution of the plant reliability list program, which is continuous and ongoing, is expected to result in improved system health, plant material condition, and overall improved plant reliability.

Some of the major factors that are forecast to impact production in 2008 and 2009, and which are discussed in more detail at Ex. E2-T1-S2 are:

- The progress of Darlington in shifting from a two-year outage cycle to a three-year outage cycle beginning in 2006 (i.e., each unit will undergo a planned outage every third year as opposed to every second year).
- A vacuum building outage at Darlington in 2009, a regulatory requirement set out in our Operating Licences, will require all four units to be shut down for approximately four weeks.
- Reductions in the duration of planned outages at Pickering B, as steps are taken to implement a targeted outage duration of 40 to 50 days.
- Improvement in the forecasted FLR at Darlington and Pickering B reflecting recent improved operating performance, offset by an increase in the FLR target at Pickering A. Pickering A has also been subject, starting in August 2007, to a three percent derate of Units 1 and 4 due to an inability by OPG to obtain Canadian Nuclear Safety Commission concurrence with OPG's shutdown system trip set point methodology.

GLOSSARY OF OUTAGE DEFINITIONS AND GENERATION PERFORMANCE INDICATORS

Calandria Tubes: Tubes that span the calandria and separate the pressure tubes from the moderator. Each calandria tube contains one pressure tube.

Corrective Maintenance: Activities associated with the repair or replacement of plant systems, equipment, components, etc., which are found to be defective, and repairing, altering, adjusting, or bringing them into conformity or making them operable. This means any work on power block equipment that has failed or is significantly degraded to the point that failure is imminent prior to the next scheduled maintenance window. Such equipment no longer conforms to or is incapable of performing its design function.

Critical Path: The longest series chain of work which determines the outage duration based on the concept that you cannot start some activities until others are finished. These activities need to be completed in a specified work sequence, with each stage being more-or-less completed before the next stage can begin. **Bulk Work** activities are activities that do not drive the critical path and can be completed "in parallel" thus not impacting outage duration.

Derate: A derate is where a unit is delivering a portion but not all of its full electrical power. Derates include:

- **Planned Derates**, which is a planned reduction in available power generation, scheduled with the IESO at least 28 days in advance.
- **Forced Derates**, which is an unplanned reduction in available power generation, which can include deratings due to licence restrictions, safety, environmental reasons, and Canadian Nuclear Safety Commission requirements.

Discovery Work: Work required to correct a deficiency that is discovered in the field after an outage begins.

Forced Outage: As per WANO industry performance reporting guidelines, a forced outage is a generator outage or derate for which OPG did not provide at least 28 days advance notice to the IESO. For purposes of clarification, the IESO defines a forced outage as an unplanned electricity system component failure (e.g., immediate, delayed, postponed, startup failure) or other condition that requires the unit be removed completely from service immediately. For the purposes of the filing, the WANO definition has been used unless otherwise stated.

Under certain infrequent circumstances (e.g., protection of equipment or the public), a utility is permitted by the IESO market rules to force a unit offline even though a request for a planned outage has been declined by the IESO. This would be classified a forced outage by OPG, and is subject to follow-up investigation by the IESO at their discretion.

Forced Production Losses: Forced production losses would represent an estimate of expected lost production due to forced outages and forced derates.

Elective Maintenance: Any work on power block equipment that is degraded.

Feeder: There are several hundred channels in the reactor that contain fuel. The *feeders* are pipes attached to each end of the channels used to circulate heavy water coolant between the fuel channels and the steam generators.

Feeder Replacement: OPG will inspect feeders to assess condition of feeder wall thickness relative to Technical Standard and Safety Authority standards; OPG will replace feeders which in OPG's assessment encroach on the Technical Standard and Safety Authority standard; with such assessments reviewed with the Canadian Nuclear Safety Commission for their concurrence and approval.

Forced Extensions of Planned Outages: An extension to a planned outage which is not scheduled with the IESO at least 28 days in advance, and is unavoidable because the unit is

not capable of safe operation at the scheduled outage completion time (e.g., an unexpected condition discovered during the scheduled outage which drives critical path).

Forced Loss Rate ("FLR"): FLR is a WANO indicator of performance reliability. FLR is a measure of the percentage of energy generation during non-planned outage periods (non-planned outage periods exclude forced extensions of planned outages) that a plant is not capable of supplying to the electrical grid because of forced production losses, such as forced outages or unplanned derates.

Lessons Learned Review: At the completion of an outage, a review of areas for improvement is conducted and documented. The review includes an analysis of actual performance against schedule performance for the purpose of improving schedule and performance for similar work in the future. The focus of the review includes: (1) scope control, (2) schedule accuracy, adherence, and stability, (3) organization effectiveness and communication, (4) work package readiness, (5) strengths, (6) improvement areas, including action plans for resolution, (7) resource availability and utilization, and (8) contingency plans.

Level I Schedule: An outage schedule produced at a summary level of detail, identifying major activities within a scheduled period of unavailability for a particular system or sub-system, with a pre-defined start and end date.

Life Cycle Plan: Life cycle management is the integration of safety management, ageing management and business management decisions, together with economic considerations over the life of a nuclear power plant in order to:

- Maintain an acceptable level of performance including safety.
- Optimize the operation, maintenance and service life of structures, systems, and components.
- Maximize returns on investment over the operational life of the nuclear power plant.
- Take account of strategies for life cycle funding (including decommissioning), fuel management, and waste management.

Maximum Continuous Rating: A station's maximum capacity measured in MW.

MegaWatt (MW = 10^6 watt): The productive capacity of electrical generators operated by utility companies. For reference, about 10,000 100-watt lightbulbs or 5,000 computer systems would be needed to draw 1 megawatt.

Operating Capacity Factor: A standard WANO indicator of performance reliability. Operating capacity factor = 100-FLR.

Pressure Tubes: Tubes that pass through the calandria and contain fuel bundles. Pressurized heavy water flows through the tubes, cooling the fuel.

Planned Outage: A planned outage is an outage which has been scheduled with the IESO at least 28 days in advance of the start date. It is subject to final approval by the IESO, the starting time of which could be postponed up to the scheduled hour of shutdown. The schedule must include the planned completion date. The planned outage duration cannot be revised (increased or decreased) after the planned outage has commenced.

Planned Outage Extensions: An extension to a planned outage, which has been scheduled with the IESO at least 28 days in advance of the planned outage extensions occurrence.

Preventive Maintenance: The activities associated with forestalling or preventing anticipated problems or the breakdown of a system, part, etc., for example:

- Maintenance procedures.
- Recalibrations.
- Work package planning and preparation.
- Obtaining/preparing work permits for work packages.
- Lubrication programmes.
- Interval replacements of equipment components.

Steam Generator: A heat exchanger that transfers heat from the heavy water coolant to ordinary water. The ordinary water boils, producing steam to drive the turbine. The *steam generator* tubes separate the reactor coolant from the rest of the power-generating system.

TeraWatt (TW = 10^6 MW): The productive capacity of electrical generators operated by utility companies.

Unit Capability Factor: Unit capability factor is a standard WANO indicator of performance reliability. Unit capability factor is the percentage of maximum energy generation that a unit/plant were capable of supplying to the electrical grid, limited only by factors within control of plant management. Unit capability factor is derived as the ratio of generation available from a unit over a specified time period divided by the maximum generation that the unit is able to produce under ambient conditions and at maximum reactor power during the same period. The available generation is reduced by planned and unplanned production losses deemed under station management's control. However, the derivation of available generation is not affected by losses due to events not under station management's control including environmental conditions (e.g., loss of transmission, lake water temperature derates, labour disputes, and potential low demand periods). While these events do impact production, they do not penalize unit capability factor as the units are considered available to produce at these times.

Unbudgeted Planned Outages: An unbudgeted planned outage is an emergent outage that was not included in the approved integrated nuclear outage and generation plan that underpins the business plan, but which OPG had sufficient time to notify the IESO at least 28 days prior to the start date. Although unbudgeted, this allows the outage to be categorized as 'planned' for performance reporting purposes as per WANO industry guidelines. If OPG moves forward with the outage but is unable to so notify the IESO within the 28 days timeframe, the outage would be designated a forced outage.

World Association of Nuclear Operators ("WANO"): An internationally recognized body with standardized performance indicators for nuclear reactors (against which OPG Nuclear benchmarks).

LIST OF ATTACHMENTS

Appendix A: Level 1 Planned Outage Schedules (Pickering B Unit 6 and Darlington Unit 4)

Appendix B: Planned Outage Milestones

APPENDIX A

Level 1 Planned Outage Schedules (Pickering B Unit 6 and Darlington Unit 4)

APPENDIX B

PLANNING OUTAGE MILESTONES

Milestone #/ Title	Accountable Manager(s)	CNO Tier 1 Indicators	Milestone TCD
01: Outage Objectives and Milestone Schedule	Manager, Outage (Strategic Planning) Manager, Outage (Pickering A)		PO-30
02: Major Scope Identified	Manager, Outage (Strategic Planning) Manager, Outage (Pickering A)		PO-24
03: Design Mods Scope Identified	Director, Engineering		PO-24
04: Revision 'A' Schedule Issued	Manager, Outage		PO-21
05: Long Lead Materials Identified	Manager, Supply Chain		PO-18
06: Phase I Assessment Complete	Manager, Maintenance		PO-14.5
07: POs Issued for LL Materials	Manager, Supply Chain		PO-14
08: Scope/Cost Challenge Meetings	Director, Work Management Manager, Outage (Pickering A)		PO-12.5
09: Scope Freeze	Manager, Outage	YES	PO-12
10: Design Permanent Mods Documents Issued	Manager, Design		PO-12
11: Labour Contracts/ PSAs Awarded	Manager, Maintenance		PO-11
12: Outage Execution Organization Identified	Manager, Outage		PO-11
13: Design Temporary Mods Documents Issued.	Manager, Engineering		PO-09
14: Revision B Schedule Issued	Manager, Outage		PO-08
15: Outage Support Documents/ Revisions Issued	Manager, Outage	YES	PO-08
16: Work Package Assessing Complete	Manager, Maintenance	YES	PO-06
17: Contingency Planning Complete	Manager, Outage		PO-04
18: Outage Pre-Reqs Scheduled	Manager, Work Control		PO-04
19: Revision C Schedule Issued	Manager, Outage	YES	PO-03
20: 95% Materials Onsite	Manager, Materials	YES	PO-03
21: Regulatory Approvals Obtained.	Manager, Engineering		PO-03
22: Pre-Outage Readiness Review Complete	Manager, Outage		PO-03
23: Work Permits Field Ready	Manager, Operations	YES	PO-02
24: Resource Profile Reconciled	Manager, Maintenance		PO-02

Milestone #/ Title	Accountable Manager(s)	CNO Tier 1 Indicators	Milestone TCD
25: Radiation Protection Support Prepared	Manager, Radiation Protection		PO-01
26: Outage Materials Staged	Manager, Maintenance		PO-01
27: Revision "0" Schedule Issued	Manager, Outage		PO-00.5
28: Walk- Downs Complete	Manager, Maintenance		PO-00.5
29: Outage Briefing Packages Ready	Manager, Outage		PO-00.5
30: Outage Metrics Prepared	Manager, Outage		PO-00.25
31: Outage Pre-requisites Complete	Manager, Maintenance	YES	PO-00
32: Outage Tools, Equipment and Facilities.	Manager, Maintenance		PO-00
33: Training Complete	Manager, Training Programs		PO-00
34: Outage Lessons Learned Compiled	Manager, Outage		PO+02

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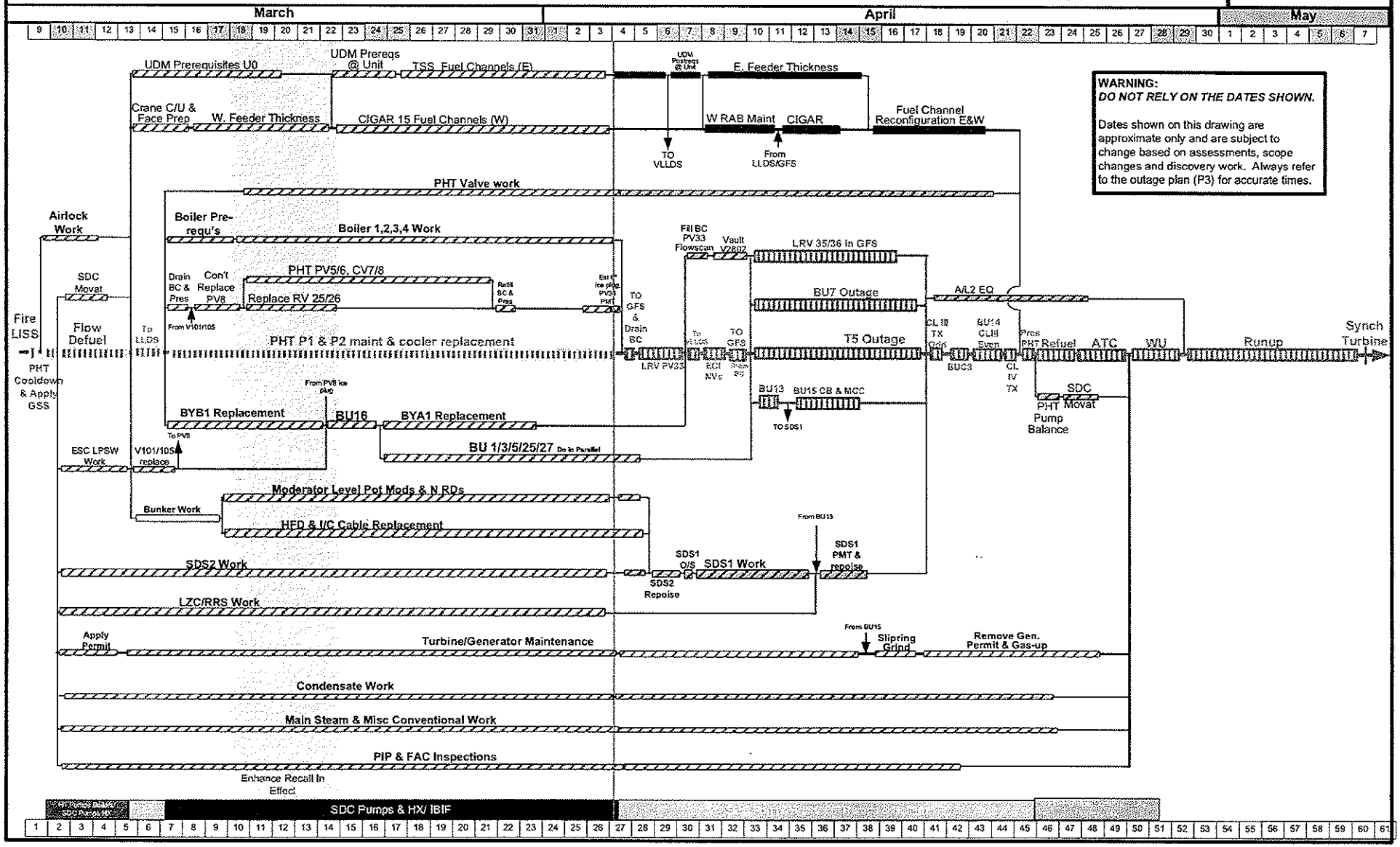
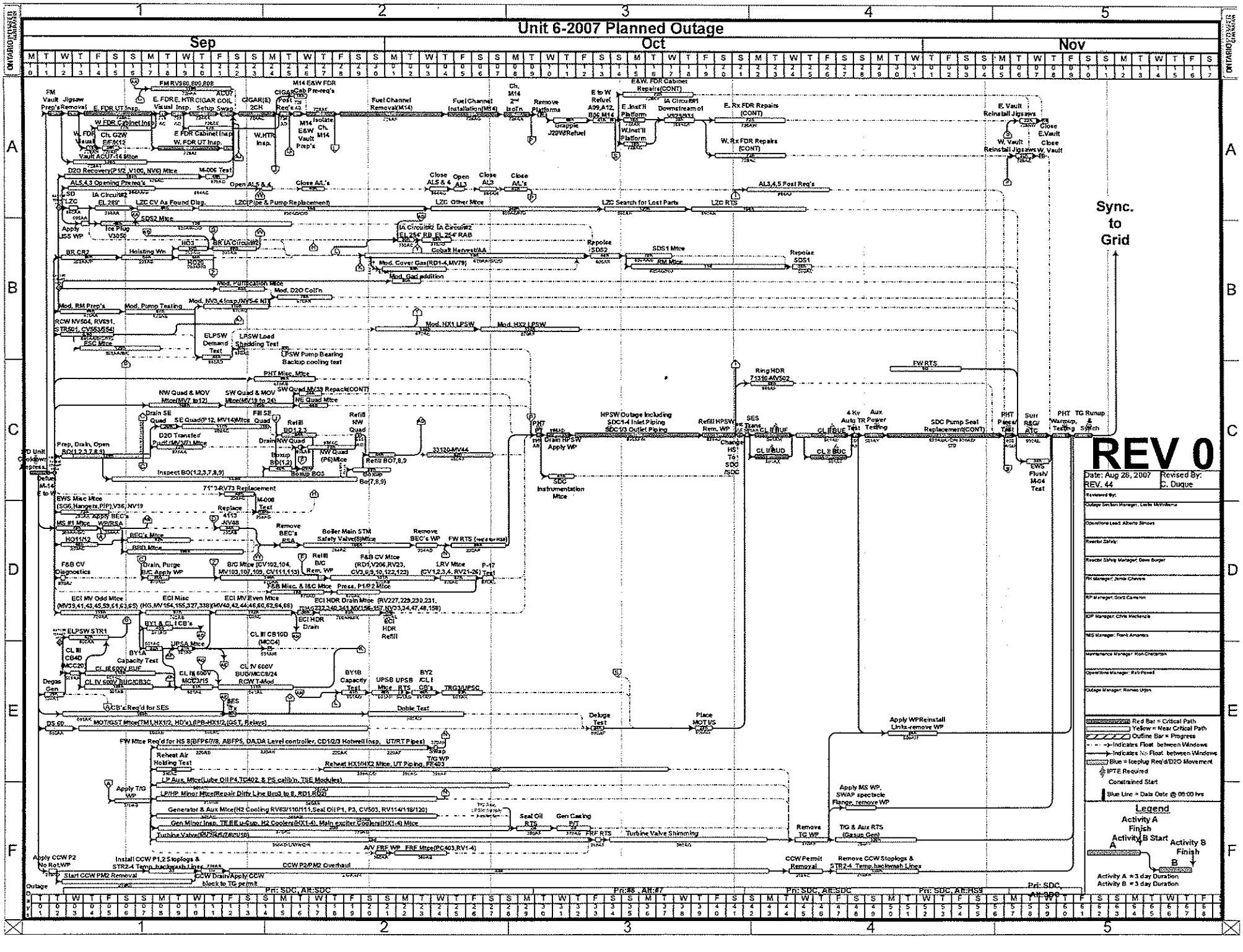
ONTARIO POWER GENERATION | Darlington Nuclear

UNIT 4 2007 OUTAGE OVERVIEW (D741)

Rev 2 April 4, 2007




Unit 6-2007 Planned Outage
Sep
Oct
Nov
Sync. to Grid
REV 0
Date: Aug 26, 2007
REV. 44
Revised By:
C. Duque
Legend
Activity A
Finish
Activity A Start
Activity B
Finish
B
Activity A = 3 day Duration
Activity B = 3 day Duration
Red Bar = Critical Path
Yellow = Near Critical Path
Outline Bar = Progress
Indicates Float between Windows
Indicates No Float between Windows
Blue = Iceplug Req'd/D2O Movement
IPTE Required
Constrained Start
Blue Line = Data Date @ 08:00 hrs
Outage
Pri: SDC, AR:SDC
Pri:#3 , AR:#7
Pri: SDC, AR:SDC
Pri: SDC, AR:HS9
Pri: SDC, AR:SDC