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Supplementary written submission from Bruce Power

Mémoire supplémentaire de Bruce Power

In the Matter of the

À l'égard de la

Opportunity to be heard on the orders issued by a Designated Officer to Bruce Power and Ontario Power Generation

Possibilité d'être entendu au sujet des ordres délivrés par un fonctionnaire désigné à Bruce Power et Ontario Power Generation

Commission Public Hearing

Audience publique de la Commission

September 10, 2021

10 septembre 2021

Canada

September 9, 2021

BP-CORR-00531-02004

Mr. M. Leblanc
Commission Secretary
Canadian Nuclear Safety Commission
P.O. Box 1046
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Ottawa, Ontario
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Dr. A Viktorov
Director General,
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Dear Mr. Leblanc and Dr. Viktorov:

Bruce A and Bruce B: Return to Service Supplemental Information

The purpose of this letter is to formally acknowledge the Commission Member Document (CMD) (Reference 1) for the Commission Hearing on September 10, 2021, and to provide additional information and analysis to address the key items identified by CNSC Staff and also demonstrate Bruce Power's compliance with the Order.

These submissions will provide additional verification in support of the Commission approval being sought by Bruce Power to Return Unit 3 to service following its planned outage and to return Units 4, 5, 7 and 8 to service following an unplanned outage.

Through sequentially planned outages, Bruce Power will deploy the Bruce Reactor Inspection Maintenance System (BRIMS) on Units 4, 5, 7 and 8 starting in November, 2021 with Unit 7. Over the subsequent 18-month period, all of these units will be inspected further through these planned and refined campaigns, based on experience from the expanded Unit 3 activities, to confirm hydrogen concentrations and no flaws in the region of interest.

In addition, a series of operational measures are being put in place where appropriate in each of these units that will continue to enhance safety margin building on the extensive defense in depth and layers of safety. Specifically, these items are focused on further reduction of risk during heat-up and cool-down which is in less than three percent of operating time.

These collective activities, combined with the submission to the Commission and additional information for verification and fitness for service steps outlined below, provide a high degree of confidence in the safety and pressure tube integrity associated with both requests.

Through extensive inspections, analysis utilizing evidence from results and testing, Bruce Power can confirm the following key principles that are core to our submission and will be reinforced through this additional information:

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1. Overall hydrogen uptake is not increasing in the pressure tubes beyond the predicted rate. It is redistribution due to a progression of total hydrogen concentration to the top of the tube in a limited region of interest that can conservatively be bounded. In the balance of the tube, hydrogen concentrations are below the licensing limits.

2. The apparent cause evaluation completed by Bruce Power, identified through two independent sources, determined the observed redistribution of [H]eq is due to the temperature gradient with the top of the pressure tube cooler than the bottom. Bruce Power is working with industry to finalize the root cause of the elevated [H]eq. While this additional verification is underway, Bruce Power is proposing a conservative region of interest, which is 120 degrees centered at 12 o'clock, with an axial dimension of 50 mm, supported by additional information.

3. From the work completed in Unit 3, the scope of future unit scrape sampling programs will be repurposed to ensure that we are identifying the bounding tubes within each reactor core and further verifying the region of interest continues to behave in the manner clearly defined through the work completed in A2131. There are no flaws in the conservatively identified region of interest. Statistical analysis collectively and on a unitized basis demonstrates no flaws in this region.

4. Due to the pressure tube and bundle configuration on the Bruce units, no flaws are expected to ever occur in this region of interest.

5. Additional operational measures are being put in place to build operational safety margin during heat-up and cool-down in particular as well during cold Primary Heat Transport (PHT) conditions where there is low but finite potential for over-pressure conditions to occur .

6. All operating units have been inspected over the last 18-months, and planned outages are sequentially scheduled to validate conclusions over the next 18 months. This is a safe, planned manner to effectively carry-out this work.

Bruce Power recognizes the CNSC staff defined a region of interest based upon information available at the time on as communicated on August 12, 2021. As stated in the CNSC CMD and from the initial criteria provided in correspondence, there was recognition that additional information and evidence would be used to further refine this criteria as appropriate.

As described in Reference 2 and based on this additional evidence and analysis being provided by Bruce Power this region can be conservatively bounded to the region of interest as follows:

- Axially – From the burnish mark to 50 mm inboard of the burnish mark, and
- Circumferentially – 60 degrees on either side of 12 o'clock for a total of 120

In support of the request to restart Unit 3 (Reference 3), and to provide a wholesome quantification of the risk of crack initiation to justify bounding the region of interest as defined above, the following additional information will be formally submitted to CNSC staff by September 17, 2021:

- All Unit 3 verified results: There were three scrape windows during A2131 scrape campaign. Attachment A includes the verified results from the first two windows. The third set of verified results will also be formally submitted to CNSC staff;

- Theoretical justification on the use of existing Delayed Hydride Crack (DHC) crack initiation model for high [H]eq application;

- Engineering evaluation of scrape flaws in the region of interest;

- Statistical analysis of existence of a significant flaw in the region of interest given lack of flaws based on inspection results to-date;

- Test plan on DHC crack initiation tests for high [H]eq, and

- Risk-informed approach to fracture protection for the region of interest.

These submissions will compliment and build upon information provided and shared over the last two months through a range of correspondence including the response to the 12(2) letter, response to the initial restart criteria, proposal to restart Unit 3 and the proposal to restart a unit from an unplanned outage.

In addition to meeting the Order and fitness for service criteria in the case of Unit 3 and to restart Units 4, 5, 7 and 8 from an unplanned outage, Bruce Power is also advancing a number of additional medium and long-term items.

Bruce Power will submit to CNSC staff the results of DHC crack initiation test on unirradiated material hydrided to high [H]eq by the end of November 2021, and over the longer-term will submit the results of DHC crack initiation test on irradiated material hydrided to high [H]eq.

Furthermore, a burst test was recently performed at 65ºC and the preliminary fracture toughness value was favourable in support of the fitness for service case. It is important to note that for burst tests to be viable in a laboratory setting a flaw is introduced to the material. This preliminary result supports the predictability and validity of the model to higher [H]eq concentration. Bruce Power will be providing the particular results and details from this test to CNSC staff.

As it relates to the request to return Units 4, 5, 7 and 8 from an unplanned outage (Reference 4), Bruce Power will formally submit, by the end of October, 2021, unit specific:

- Engineering evaluations of scrape flaws in the region of interest, and
- Statistical analysis of existence of a significant flaw in the region of interest given lack of flaws based on inspection results to-date; and statistical analysis.

Bruce Power believes this additional information will meet the requirements of CNSC Staff to further verify the conclusions we have made. Bruce Power is requesting consideration of these two matters before the Commission given the demonstration of compliance with the Order and the additional information being provided for verification of fitness for service requirements.

Upon the return to service of Unit 3, Bruce Power will direct resources to the Unit 7 planned inspection campaign and sequentially move through all of the Units in the timeline outlined, in addition to completing a Bruce A Vacuum Building Outage and Station Containment Outage in the second quarter of 2022.

This approach also aligns with operational and outage planning to effectively, sequentially and safely carry-out these activities in a planned manner. Furthermore, with respect to unplanned outages, this will provide the operational clarity during unplanned outage conditions to enable safe and controlled work execution.

If you require further information or have any questions regarding this submission, please contact Mr. Maury Burton, Chief Regulatory Officer, Corporate Affairs and Operational Services, at (519) 361-2673 extension 15291, or maury.burton@brucepower.com.

Yours truly,

Maury Burton
Chief Regulatory Officer
Bruce Power

cc: CNSC Bruce Site Office
Mr. L. Sigouin, CNSC Ottawa

Attach.

References:

1. Commission Member Document, “CNSC staff assessment of the requests for restart submitted by Bruce Power and OPG pursuant to Orders issued due to hydrogen equivalent concentration discovery events at Bruce NGS A and B”, September 3, 2021, e-Doc 6634528, CMD-21-H11.
2. Letter, M. Burton to L. Sigoiun, “Bruce A and B: CNSC Staff Assessment Criteria for Restart Requirements”, August 20, 2021, BP-CORR-00531-01966.
3. Letter, M. Burton to M. Leblanc, “Designated Officer Order to Bruce Power - Unit 3 Planned Outage Restart Authorization”, August 13, 2021, BP-CORR-00531-01935.
4. Letter, M. Burton to M. Leblanc, “Designated Officer Order to Bruce Power – Unplanned Outage Restart Request”, August 4, 2021, BP-CORR-00531-01908.

Attachment A

Summary of HVEMS/TDMS Outlet RJ Measurements at the A2131 Outage time

Table 1- Summary of HVEMS/TDMS Outlet RJ measurements at the A2131 Outage time

Ch. ID (FEO /BEO)	Nominal Location (o'clock from ORJ end)	Location (from Outlet end (mm) **(Note 1)**	$[D]_{meas}$ (ppm)	$[H]_{meas}$ (ppm)	$[H]i_{initial}$ (offcut) ppm	[H]eq (ppm) $[D]_{meas}/2+[H]_{initital}$	Burnish Mark Loc. based on UT (mm) **(Note 2)**
F16 (FEO)	O1 (+20)	9	1340	111	12.6	682.6	68
	O1 (-20)	9	930	80		477.6	
	O3 (+20)	42	880	79		452.6	
	O4 (+20) BM-10	54	670	67		347.6	
	O4 (-20) BM-10	54	310	29		167.6	
	O4 (-90) BM-10	55	115	15		70.1	
	O4H- (+50) BM-10	56	123	16		74.1	
	O4H+ (-66) BM-10	56	115	13		70.1	
	O4B- (+20) BM+20	90	180	23		102.6	
	O4BT (-8) BM+20	**89**	**300**	**34**		**162.6**	
	O4B+ (-38) BM+20	89	119	18		72.1	
	O4A (+20) BM+43	112	240	31		132.6	
	O4A (-90) BM+43	113	96	16		60.6	
	O5 (+20)	128	190	29		107.6	
	O6 (+20)	370	71	22		48.1	
	O6 (-20)	345	69	20		47.1	
L11 (FEO)	O1 (+20)	9	790	60	9.3	404.3	68
	O1 (-20)	9	132	13		75.3	
	O3 (+20)	42	470	37		244.3	
	O3 (-20)	40	121	13		69.8	
	O4 (+20) BM-10	54	350	29		184.3	

Ch. ID (FEO /BEO)	Nominal Location (o'clock from ORJ end)	Location (from Outlet end (mm) **(Note 1)**	$[D]_{meas}$ (ppm)	$[H]_{meas}$ (ppm)	$[H]i_{initial}$ (offcut) ppm	[H]eq (ppm) $[D]_{meas}/2+[H]_{initital}$	Burnish Mark Loc. based on UT (mm) **(Note 2)**
	O4 (-20) BM-10	54	115	14		66.8	
	O4 (-90) BM-10	55	96	12		57.3	
	O4H- (+50) BM-10	57	108	11		63.3	
	O4H+ (-66) BM-10	57	98	11		58.3	
	O4B- (+20) BM+20	90	136	14		77.3	
	O4BT (-8) BM+20	**90**	**137**	**15**		**77.8**	
	O4B+ (-38) BM+20	89	101	17		59.8	
	O4A (-20) BM+43	113	99	12		58.8	
	O4A (-90) BM+43	114	88	11		53.3	
	O5 (+20)	128	115	15		66.8	
	O6 (+20)	370	67	14		42.8	
G15 (FEO)	O1 (+8)	10	1016	103	11.3	519.4	69
	O3 (+8)	43	739	75		380.9	
	O4 (+8) BM-10	56	531	63		276.6	
	O4 (+60) BM-10	56	119	23		70.8	
	O4 (-20) BM-10	56	152	22		87.4	
	O4 (-90) BM-10	57	104	18		63.5	
	O4H+(-66) BM-10	58	102	19		62.3	
	O4B-(+22) BM+20	91	183	31		102.8	
	O4BT(-8)	92	**227**	**34**		**124.8**	

Ch. ID (FEO /BEO)	Nominal Location (o'clock from ORJ end)	Location (from Outlet end (mm) **(Note 1)**	$[D]_{meas}$ (ppm)	$[H]_{meas}$ (ppm)	$[H]i_{initial}$ (offcut) ppm	[H]eq (ppm) $[D]_{meas}/2+[H]_{initital}$	Burnish Mark Loc. based on UT (mm) **(Note 2)**
	BM+20						
	O4B+(-38) (BM+20)	92	107	23		64.8	
	O4A (+8) BM+43	114	178	30		100.3	
	O6 (+8)	371	70	18		46.3	
K10 (FEO)	O1 (+8)	9	853	74	7.4	433.9	68
	O3 (+8)	41	496	50		255.2	
	O4 (+8) BM-10	55	330	35		172.2	
	O4 (+60) BM-10	55	126	30		70.4	
	O4 (-90) BM-10	56	95	23		54.7	
	O4H+ (-66) BM-10	57	102	16		58.4	
	O4B- (+22) BM+20	89	144	27		79.4	
	O4BT (-8) BM+20	89	**152**	**26**		**83.4**	
	O4B+ (-38) BM+20	90	103	19		58.9	
	O4A (+8) BM-10	113	120	26		67.3	
	O4A (-90) BM-10	113	80	16		47.6	
	O6 (+8)	370	60	29		37.6	
Q16 (FEO)	O1 (+8)	9	730	96	10.9	376.0	68
	O3 (+8)	42	441	61		231.4	
	O4 (+8) BM-10	55	314	51		167.9	
	O4 (+60) BM-10	55	93	21		57.6	
	O4 (-20) BM-10	55	152	29		87.0	

Ch. ID (FEO /BEO)	Nominal Location (o'clock from ORJ end)	Location (from Outlet end (mm) **(Note 1)**	$[D]_{meas}$ (ppm)	$[H]_{meas}$ (ppm)	$[H]i_{initial}$ (offcut) ppm	[H]eq (ppm) $[D]_{meas}/2+[H]_{initital}$	Burnish Mark Loc. based on UT (mm) **(Note 2)**
	O4 (-90) BM-10	56	87	26		54.5	
	O4H+(-66) BM-10	56	95.0	21		58.4	
	O4B-(+22) BM+20	89	111.0	40		66.4	
	O4BT(-8) BM+20	90	**168.0**	**33**		**94.9**	
	O4B+(-38) BM+20	89	104.0	34		62.9	
	O4A (+8) BM+43	113	130	32		75.8	
	O6 (+8)	370	68	26		44.9	
H06 (FEO)	O1T (-8)	9	310	66		170.0	
	O3T(-8)	42	210	49		120.0	
	O4T(-8) (BM-10)	57	171	42		100.5	
	O4BT(-8) (BM+20)	89	**122**	**40***	15	**76.0**	67
	O4BH+(-66) (BM+20)	88	76	21		53.0	
	O4AT(-8) (BM+43)	112	104	41*		67.0	
	O6T(-8)	394	59	27		44.5	
X09 (FEO)	O1T (-8)	11	475	73		252.4	
	O3T(-8)	44	238	42		133.9	
	O4T(-8) (BM-10)	58	186	40		107.9	
	O4BT(-8) (BM+20)	**90**	**118**	**24**	14.9	**73.9**	68
	O4BH+(-66) (BM+20)	89	93	27		61.4	
	O4AT(-8) (BM+43)	113	107	24		68.4	
	O6T(-8)	396	53	26		41.4	

Ch. ID (FEO /BEO)	Nominal Location (o'clock from ORJ end)	Location (from Outlet end (mm) **(Note 1)**	$[D]_{meas}$ (ppm)	$[H]_{meas}$ (ppm)	$[H]i_{initial}$ (offcut) ppm	[H]eq (ppm) $[D]_{meas}/2+[H]_{initital}$	Burnish Mark Loc. based on UT (mm) **(Note 2)**
O20 (FEO)	O1T(-8)	10	921.0	96.0	12.3	472.8	67
	O4T(-8) (BM-10)	56	451.0	53.0		237.8	
	O4BT(-8) (BM+20)	**89**	**218.0**	**35.0**		**121.3**	
	O6T(-8)	395	64.0	26.0		44.3	
Q12 (FEO)	O1T(-8)	11	850	99	10.3	435.3	67
	O3T(-8)	42	620	75		320.3	
	O4T(-8) (BM-10)	57	400	52		210.3	
	O4BT(-8) (BM+20)	**90**	**185**	**30**		**102.8**	
	O4BH+(-66) (BM+20)	89	89	18		54.8	
	O4AT(-8) (BM+43)	112	142	29*		81.3	
	O6T(-8)	395	67	23*		43.8	
N04 (BEO)	O2T (-8)	27	337	58	14.7	183.2	69
	O4T (-8)	58	205	40		117.2	
	O4H+(-66) (BM-10)	57	87	22		58.2	
	O4H-(+50) (BM-10)	57	92	28		60.7	
	O4BT (-8) (BM+20)	**91**	**120**	**29**		**74.7**	
	O4B- (+22) (BM+20)	91	104	32		66.7	
	O4AT (-8) (BM+43)	114	100	28		64.7	
O15 (BEO)	O1T (-8)	12	303	56	8.7	160.2	69
	O3T (-8)	43	185	35		101.2	
	O4T (-8) (BM-10)	58	151	31		84.2	
	O4H+(-66)	57	79	21		48.2	

Ch. ID (FEO /BEO)	Nominal Location (o'clock from ORJ end)	Location (from Outlet end (mm) **(Note 1)**	$[D]_{meas}$ (ppm)	$[H]_{meas}$ (ppm)	$[H]i_{initial}$ (offcut) ppm	[H]eq (ppm) $[D]_{meas}/2+[H]_{initital}$	Burnish Mark Loc. based on UT (mm) **(Note 2)**
	(BM-10)						
	O4H-(+50) (BM-10)	57	83	21		50.2	
	O4BT (-8) (BM+20)	89	107	25		**62.2**	
	O4AT (-8) (BM+43)	113	94	24		55.7	
O17 (BEO)	O1T (-8)	11	122	28	9.0	70.0	68
	O3T (-8)	43	110	23		64.0	
	O4T (-8) (BM-10)	57	103	26		60.5	
	O4H+(-66) (BM-10)	56	83	22		50.5	
	O4H-(+50) (BM-10)	57	86	35		52.0	
	O4BT (-8) (BM+20)	89	94	23		**56.0**	
	O4AT (-8) (BM+43)	114	89	20		53.5	
O13 (BEO)	O1T (-8)	11	443	72	12.5	234.0	69
	O3T (-8)	43	298	45		161.5	
	O4T (-8) (BM-10)	57	216	50		120.5	
	O4H+(-66) (BM-10)	56	98	33		61.5	
	O4H-(+50) (BM-10)	56	96	32		60.5	
	O4BT (-8) (BM+20)	89	126	29		**75.5**	
	O4AT (-8) (BM+43)	112	108	26		66.5	
P14 (BEO)	O1T (-8)	10	191	34	9.0	104.5	68
	O3T (-8)	42	125	24		71.5	
	O4T (-8) (BM-10)	56	108	24		63.0	

Ch. ID (FEO /BEO)	Nominal Location (o'clock from ORJ end)	Location (from Outlet end (mm) **(Note 1)**	$[D]_{meas}$ (ppm)	$[H]_{meas}$ (ppm)	$[H]i_{initial}$ (offcut) ppm	[H]eq (ppm) $[D]_{meas}/2+[H]_{initital}$	Burnish Mark Loc. based on UT (mm) **(Note 2)**
	O4H+(-66) (BM-10)	55	79	20		48.5	
	O4H-(+50) (BM-10)	56	80	21		49.0	
	O4BT (-8) (BM+20)	88	91	20		**54.5**	
	O4AT (-8) (BM+43)	111	86	22		52.0	
Q13 (BEO)	O1T (-8)	12	582	87	11.7	302.7	69
	O3T (-8)	43	467	73		245.2	
	O4T (-8) (BM-10)	59	341	61		182.2	
	O4H+(-66) (BM-10)	57	89	21		56.2	
	O4H-(+50) (BM-10)	58	91	21		57.2	
	O4BT (-8) (BM+20)	91	183	35		**103.2**	
	O4AT (-8) (BM+43)	114	139	29		81.2	
L12 (BEO)	O1T (-8)	10	156	27	6.7	84.7	69
	O3T (-8)	42	111	20		62.2	
	O4T (-8) (BM-10)	57	99	23		56.2	
	O4H+(-66) (BM-10)	56	86	21		49.7	
	O4H-(+50) (BM-10)	57	79	17		46.2	
	O4BT (-8) (BM+20)	90	87	18		**50.2**	
	O4AT (-8) (BM+43)	113	83	19		48.2	
F05 (BEO)	O1T (-8)	11	75	25	11.7	49.2	68
	O3T (-8)	43	82	25		52.7	
	O4T (-8)	57	82	23		52.7	

Ch. ID (FEO /BEO)	Nominal Location (o'clock from ORJ end)	Location (from Outlet end (mm) **(Note 1)**	$[D]_{meas}$ (ppm)	$[H]_{meas}$ (ppm)	$[H]i_{initial}$ (offcut) ppm	[H]eq (ppm) $[D]_{meas}/2+[H]_{initital}$	Burnish Mark Loc. based on UT (mm) **(Note 2)**
	(BM-10)						
	O4H+(-66) (BM-10)	57	72	25		47.7	
	O4H-(+50) (BM-10)	57	74	21		48.7	
	O4BT (-8) (BM+20)	90	76	21		49.7	
	O4AT (-8) (BM+43)	114	69	27		46.2	
L22 (BEO)	O1T (-8)	12	42	24	9.3	30.3	69
	O3T (-8)	43	41	14		29.8	
	O4T (-8) (BM-10)	58	42	21		30.3	
	O4H+(-66) (BM-10)	57	41	18		29.8	
	O4H-(+50) (BM-10)	58	43	19		30.8	
	O4BT (-8) (BM+20)	91	42	21		**30.3**	
	O4AT(-8) (BM+43)	114	43	18		30.8	
R10 (BEO)	O1T(+8)	8	199	26	5.5	105.0	68
	O2T(+8)	23	161	26		86.0	
	O3T(+8)	40	122	20		66.5	
	O4AT(+8) (BM+43)	112	93	16		52.0	
	O6T(+8)	367	56	16		33.5	
S13 (BEO)	O1T(-8)	11	314	38	6.0	163.0	69
	O3T(-8)	44	163	21		87.5	
	O4T(-8) (BM-10)	57	133	19		72.5	
	O4H+(-66) (BM-10)	56	97	16		54.5	
	O4H-(+50) (BM-10)	58	97	15		54.5	

Ch. ID (FEO /BEO)	Nominal Location (o'clock from ORJ end)	Location (from Outlet end (mm) **(Note 1)**	$[D]_{meas}$ (ppm)	$[H]_{meas}$ (ppm)	$[H]i_{initial}$ (offcut) ppm	[H]eq (ppm) $[D]_{meas}/2+[H]_{initital}$	Burnish Mark Loc. based on UT (mm) **(Note 2)**
	O4BT(-8) (BM+20)	90	105	17		**58.5**	
	O4AT(-8) (BM+43)	112	98	17		55.0	

Notes to Table 1:

1 The axial locations are based on UT from 3rd window, otherwise are estimated based on scrape locations relative to E-face provided in the CWEST inspection report and the channel specific EF to End of PT distance is used from V&D.

2 BM locations are estimated based on information provided to support CWEST scrape sampling from 3rd window where available, otherwise the minimum design is used.

Table 2- Summary of HVEMS/TDMS Inlet RJ measurements at the A2131 Outage time

Ch. ID (BEI/ FEI)	Nominal Location (o'clock)	Location (from Outlet end (mm) **(Note 1)**	$[D]_{meas}$ (ppm)	$[H]_{meas}$ (ppm)	$[H]i_{initial}$ (offcut) ppm	[H]eq (ppm) $[D]_{meas}/2+[H]_{initital}$	Burnish Mark Loc. based on UT (mm) **(Note 2)**
F16 (BEI)	I4T(+8) (BM-10)	59	53	16	12.6	39.1	69
	I4H-(-50) (BM-10)	59	54	17		39.6	
	I4H+(+66) (BM-10)	59	53	15		39.1	
G15 (BEI)	I1T(+8)	8	130.0	46.0	11.3	76.3	69
	I4T(+8) (BM-10)	55	54.0	25.0		38.3	
	I4AT(+8) (BM+43)	110	41.0	18.0		31.8	
	I6T(+8)	395	14.0	28.0		18.3	
K10 (BEI)	I1T(+8)	9	169.0	32.0	7.4	91.9	68
	I4T(+8) (BM-10)	55	65.0	23.0		39.9	
	I4AT(+8) (BM+43)	111	48.0	15.0		31.4	
	I6T(+8)	394	15.0	16.0		14.9	
L11 (BEI)	I4T(+8) (BM-10)	55	63	13	9.3	40.8	69
	I4H-(-50) (BM-10)	55	63	15		40.8	
	I4H+(+66) (BM-10)	55	63	11		40.8	
O10 (BEI)	I2T(+8)	25	177.0	50.0	12.7	101.2	70
	I4H-(-50) (BM-10)	56	69.0	21.0		47.2	
	I4T(+8) (BM-10)	56	69.0	23.0		47.2	
	I4H+(+66) (BM-10)	56	66.0	25.0		45.7	
	I4A-(-22) (BM+43)	112	46.0	18.0		35.7	

Ch. ID (BEI/ FEI)	Nominal Location (o'clock)	Location (from Outlet end (mm) **(Note 1)**	$[D]_{meas}$ (ppm)	$[H]_{meas}$ (ppm)	$[H]i_{initial}$ (offcut) ppm	[H]eq (ppm) $[D]_{meas}/2+[H]_{initital}$	Burnish Mark Loc. based on UT (mm) **(Note 2)**
	I4AT(+8) (BM+43)	112	46.0	49.0		35.7	
	I4A+(+38) (BM+43)	113	45.0	20.0		35.2	
	I6T(+8)	396	13.0	20.0		19.2	
O20 (BEI)	I2T(+8)	26	139.0	33.0	12.3	81.8	70
	I4T(+8) (BM-10)	57	57.0	18.0		40.8	
	I4AT(+8) (BM+43)	113	44.0	18.0		34.3	
	I6T(+8)	396	12.0	23.0		18.3	
Q16 (BEI)	I2T(+8)	27	89.0	26.0	10.9	55.4	71
	I4T(+8) (BM-10)	58	56.0	20.0		38.9	
	I4AT(+8) (BM+43)	114	45.0	28.0		33.4	
	I6T(+8)	397	16.0	72.0*		18.9	

Notes to Table 2:

1. The axial locations are based on UT from 3rd window, where available, otherwise are estimated based on scrape locations relative to E-face provided in the CWEST inspection report and the channel specific EF to End of PT distance is used from V&D.
2. BM locations are estimated based on information provided to support CWEST scrape sampling from 3nd window where available, otherwise the minimum design is used.