Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

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Supplementary Information

Written submission from Ontario Power Generation

In the Matter of

Request for authorization to return Pickering Nuclear Generating Station Unit 5 to service, following its current forced outage

Public Hearing - Hearing in writing based on written submissions

October 2021

Renseignements supplémentaires

Mémoire d' Ontario Power Generation

À l'égard de

Demande concernant l'autorisation de la remise en service de la tranche 5 de la centrale nucléaire de Pickering à la fin de son arrêt prévu actuel

Audience Publique - Audience fondée sur des mémoires

Octobre 2021

Canada

ONTARIO POWER GENERATION

Jon Franke
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Pickering Generating Station

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OPG Proprietary

October 6, 2021

CD# NK30-CORR-00531-08334

MR. M. LEBLANC
Commission Secretary

DR. A. VIKTOROV
Director General

Canadian Nuclear Safety Commission
280 Slater Street
Ottawa, Ontario
K1P 5S9

Dear Mr. Leblanc and Dr. Viktorov:

Pickering NGS: OPG responses to CNSC staff inquiries related to OPG's request for expedited authorization to restart following the Pickering Unit 5 2021 fall forced outage

The purpose of this letter is to provide, for the record, the OPG responses to inquiries from CNSC staff related to References 1 and 2. The information in Attachments 1 through 4 supports the request made in Reference 1 and supports OPG's affirmation that Pickering Unit 5 remains fit for service, within the licensing basis, and can safely return to service following the current forced outage.

If you have any questions or require any clarification regarding this submission, please contact Sara Irvine, Manager Regulatory Affairs at (905) 622-0710 or by email at sara.irvine@opg.com.

Sincerely,

Jon Franke
Senior Vice President
Pickering Nuclear
Ontario Power Generation Inc.

cc: R. Jammal - CNSC (Ottawa)
J. Burta - CNSC (Ottawa)
K. Campbell - CNSC (Ottawa)
C. Chan - CNSC Site Office (Pickering)

Attachments:

1. OPG Responses to CNSC Questions regarding OPG's September 29th Submission (NK30-CORR-00531-08328).

2. Fuel Channel Assemblies Shield Plug Assembly NK30-GDN-31130-0001-001 Rev 2.

3. Fuel Channel Assembly Major Assembly NK30-GEN-31100-0004-U5-001.

4. OPG Responses to CNSC Questions regarding OPG's October 1st Request for Expedited Authorization to Restart Following Pickering Unit 5 2021 Fall Forced Outage.

References:

1. OPG Letter, J. Franke to M. Leblanc and A. Viktorov, "Pickering NGS: Request for Authorization to restart following the Pickering Unit 7 fall outage 2021 and pre-authorization to restart following any Pickering Units 5-8 Forced Outage with Heat Transport System Cooldown", September 29, 2021, CD# NK30-CORR-00531-08328.

2. OPG Letter, J. Franke to M. Leblanc and A. Viktorov, "Pickering NGS: Request for expedited authorization to restart following the Pickering Unit 5 2021 fall forced outage", October 1, 2021, CD# NK30-CORR-00531-08332.

Attachment 1 to OPG Letter, J. Franke to M. Leblanc and A. Viktorov, “Pickering NGS: OPG responses to CNSC staff inquiries related to OPG’s request for expedited authorization to restart following the Pickering Unit 5 2021 fall forced outage”, CD# NK30-CORR-00531-08334.

Attachment 1

OPG Responses to CNSC Questions regarding OPG’s September 29th Submission (NK30-CORR-00531-08328)

CNSC Overall Question:

Fig 1 of the attachment (page 17/33) shows two dispositionable flaws (P5O05-IND1 and P6N04-IND9) at ~ 200 degrees (around 6 o clock) and we need more information on those two flaws. Specifically we are looking for the following.

CNSC Question 1:

The type of the flaw and why it was formed. OPG need to explain why the flaw formed at that location when no bundle bearing pads are present at that location.

OPG Response to CNSC Question 1:

P5O05-IND1 and P6N04-IND9 are classified as debris flaws. Formation of flaws at this axial location away from the region of interest, while infrequent, can occur when fuel interacts with the bottom of the pressure tube during normal handling. Debris caught within fuel during this cycle can transition over the bottom part of the pressure tube and cause a debris type flaw.

For a flaw to occur at the top of the pressure tube, where there is no interaction with fuel during normal handling, a bundle would need to be stuck in crossflow for an extended period of time as highlighted in our responses to the 12(2) order. Pickering has identified all flaws created by crossflow bearing pad fretting and has since developed operational procedures to prevent further flaw formation by this mechanism.

It should be noted, as highlighted in our submission (Enclosure 1 of Reference 1), that flaw tip hydride accumulation and resistance to cracking under hydride ratcheting conditions is governed by peak temperature during hydride formation and not the bulk [Heq]. Other parameters such as KIH and pc are not affected by bulk [Heq] (see Enclosure 2 of Reference 2). As previously documented, fitness for service of both flaws has been demonstrated to the planned end of life with postulated [Heq] up to 359 ppm (see Appendix A of Enclosure 1 of Reference 3). This [Heq] bounds the Bruce Power Outlet Rolled Joint (ORJ) [Heq] observations, noting that OPG has never experienced similar high levels of [Heq] as observed at Bruce Power.

Attachment 1 to OPG Letter, J. Franke to M. Leblanc and A. Viktorov, "Pickering NGS: OPG responses to CNSC staff inquiries related to OPG's request for expedited authorization to restart following the Pickering Unit 5 2021 fall forced outage", CD# NK30-CORR-00531-08334.

CNSC Question 2:

Time of formation or detection, dimensions of the flaw, and whether the flaw was ever re-inspected.

OPG Response to CNSC Question 2:

P5O05-IND1:

- Originally detected via CIGAR in the 1999 P5 Outage during the first volumetric inspection of channel P5O05.
- Dimensions:
  - Length: 4.6 mm
  - Width 1.2 degrees
  - Depth: 0.17 mm
- This flaw has not been re-inspected.

P6N04-IND9:

- Originally detected via CIGAR in 2001 (P161 Outage) during the first volumetric inspection of channel P6N04 (this flaw was also replicated during that outage).
- Dimensions:
  - Length: 13.0 mm
  - Width: 6.7 mm
  - Depth: 0.34 mm
- This flaw was re-inspected via ANDE in 2005 (P561 Outage) and again in 2009 (P961 Outage) with no evidence of change in flaw dimensions.

As noted, fitness for service of both flaws has been demonstrated to the planned end of life with postulated [Heq] up to 359 ppm (see Appendix A of Enclosure 1 of Reference 3). This [Heq] bounds the Bruce Power ORJ [Heq] observations, noting that OPG has never experienced similar high levels of [Heq] as observed at Bruce Power.

CNSC Question 3:

A description of the configuration of the shield plug in Pickering B reactors and particularly in Unit 5 and how those two dispositionable flaws could be formed in the region of interest given there are no fuel bundles there, only the shield plug.

OPG Response to CNSC Question 3:

The configuration of the P5-8 shield plug is shown per the attached documents:

- P5-8 Shield Plug Assembly (See Attachment 2 - NK30-GDN-31130-0001-001)
- P5 Fuel Channel Assembly (See Attachment 3 - NK30-GEN-31100-0004-U5-0001)

Although infrequent, when fuel with entrained debris interacts with the bottom of the pressure tube during fuelling, it is possible for flaws to form (only 2 debris flaws have been discovered in this area from 225 unique pressure tube inspections).

CNSC Question 4:

Have OPG ever measured the hydrogen concentrations in those two channels, if yes, what was the measurements?

OPG Response to CNSC Question 4:

P5O05:

- The hydrogen concentration in this pressure tube has not been measured.
- The [Hinitial] in this channel is typical of P5 pressure tubes at 10.0 ppm. For comparison, the highest [Hinitial] in any P5 pressure tube is 19.5 ppm in channel P5G03.

P6N04:

- The hydrogen concentration in this pressure tube has been measured via Body of Tube (BOT) scrape sampling in 2001 (P161), 2004 (P461), and 2009 (P961):

Year	[Heq], 1.5 m* (ppm)	[Heq], 4.0 m* (ppm)	[Heq], 5.0 m* (ppm)	[Heq], 5.6 m* (ppm)
2001	5.9	N/A	N/A	N/A
2004	N/A	10.5	10.7	N/A
2009	6.6	13.4	13.2	12.0

  * Nominal axial location of scrape sample
- The [Hinitial] in this pressure tube is low at 4.4 ppm. For comparison, the highest [Hinitial] in any P6 pressure tube is 14.0 ppm in channel P6M22.

As noted, flaw tip hydride accumulation and resistance to cracking under hydride ratcheting conditions is governed by peak temperature during hydride formation and not the bulk [Heq]. Thus, even in the unlikely event that there were a severe flaw in a region with elevated [Heq], the concentration in excess of TSSD would not affect flaw-tip hydride accumulation, meaning there would be little incremental impact of elevated [Heq] on flaw assessment outcomes (see Enclosure 2 of Reference 2).

As noted earlier, P5O05-IND1 and P6N04-IND9 have both been demonstrated as fit for service to the planned end of life with [Heq] up to 359 ppm. This postulated level of [Heq] bounds the elevated [Heq] observed in Bruce Power ORJs, and provides high confidence that both flaws remain acceptable for continued operation. It should again be reiterated that OPG has never experienced similar high levels of [Heq] as observed at Bruce Power and thus these assessments are substantially conservative.

References:

[1] OPG Letter, J. Franke to M. Leblanc and A. Viktorov, “Pickering NGS: Request for Authorization to restart following the Pickering Unit 7 fall outage 2021 and pre-authorization to restart following any Pickering Units 5-8 Forced Outage with Heat Transport System Cooldown”, OPG CD# NK30-CORR-00531-08328, September 28, 2021.

[2] OPG Letter, M. R. Knutson to M. Leblanc and A. Viktorov, “OPG Response to Request pursuant to Subsection 12(2) of the General Nuclear Safety and Control Regulations: Responses to Items 1-4 Related to Measurement of Hydrogen Concentration in Pressure Tubes”, OPG CD# N-CORR-00531-22801, July 30, 2021.

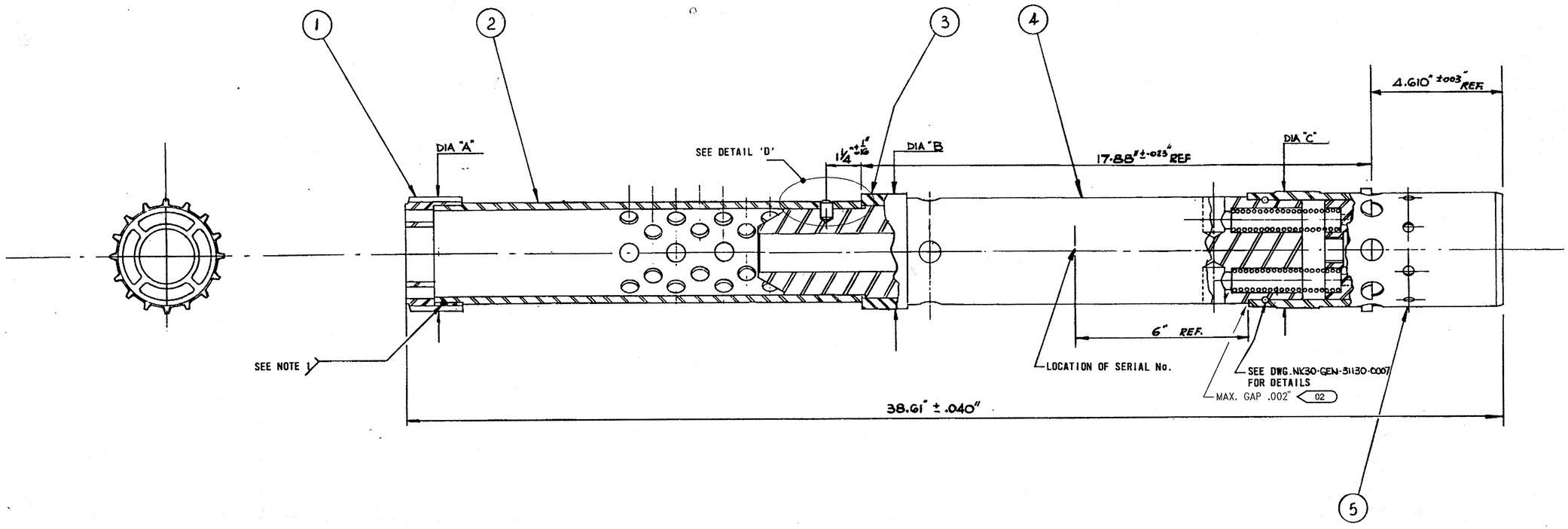
[3] OPG Letter, S. Gregoris and J. Franke to M. Leblanc, “Pickering and Darlington NGS: Submission of Supplemental Information in Response to Designated Officer Orders and to Support Opportunity to be Heard Public Hearing”, OPG CD# N-CORR-00531-22866, September 8, 2021.

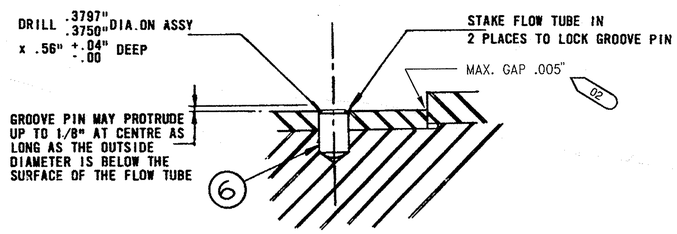
Attachment 2

Fuel Channel Assemblies
Shield Plug Assembly

NK30-GDN-31130-0001-001 Rev 2

Total Pages: 2 (including this page)





DETAIL 'D'

SCALE : 1/1

NOTES:

1. WELDING PROCEDURES FOR TIG WELDING ITEM 1 TO ITEM 2 AT 2 PLACES TO BE SUBMITTED TO A.E.C.L. FOR APPROVAL.
2. AFTER ASSY DIA'S. 'A' 'B' & 'C' TO BE CONCENTRIC WITHIN .020" T.I.R.
3. NO PARTICULAR ORIENTATION IS REQUIRED BETWEEN ITEMS 1 2 & 4.
4. SEE TECHNICAL SPEC. TS-30-31130-3 FOR ASSEMBLY AND TESTING DETAILS
5. FOR L.S.F.C.R OR FUEL CHANNEL REPLACEMENT SEE DWG 44RR-DCN-31120-0006

STOCK CODE Nº 590M5744

DRAWING ISSUED FOR

ISSUE NO.	REV. NO.	DESCRIPTION	DATE	APPROVED BY
1	00	TENDER 1434	17/11/76	
2	00	" 1956	21/11/76	
3	00	FAB 1583	4-1-77	
4	00	TEND (P44 L.S.F.C.R) 1055	84/5/1	

DRAWING TRANSFERRED TO ONTARIO HYDRO
E0640 AT REV. NO. 00 DATE Jan. 18/89

A.E.C.L. PROPRIETARY

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ATOMIC ENERGY OF CANADA LIMITED
Power Projects, Sheridan Park Research Community
Mississauga, Ontario L5K 1B2

rev no	date	particulars	dwn / chkd	design / vrfd	AEC / Authorize
02	1998 AUG 11	REVISED AS PER EIT #98-0129M, TOLERANCE DIMENSIONS ADDED.	PB / PB	mb / Lg.	mb / [illegible]

D & WS Design DS

INDEXED

E1634

NO.	DATE	REVISIONS	LOCATION	BY	APP'D.
1	891128	NOTE 5 ADDED	TD		
0	78-09-25	DRAWING NOT AFFECTED. SEE REV. SHT.			

DRAWN P.E. ATKINSON CHECKED 22 May '75
DESIGNED A. J. Lindsay May 8/76
APPROVED L.K. Barnett MAR 9/76
SCALE 1/2x Full Size

PICKERING G.S. 'B' UNITS 5678

FUEL CHANNEL ASSEMBLIES
SHIELD PLUG ASSEMBLY

NK30-GDN-31130-0001-001 REV 02

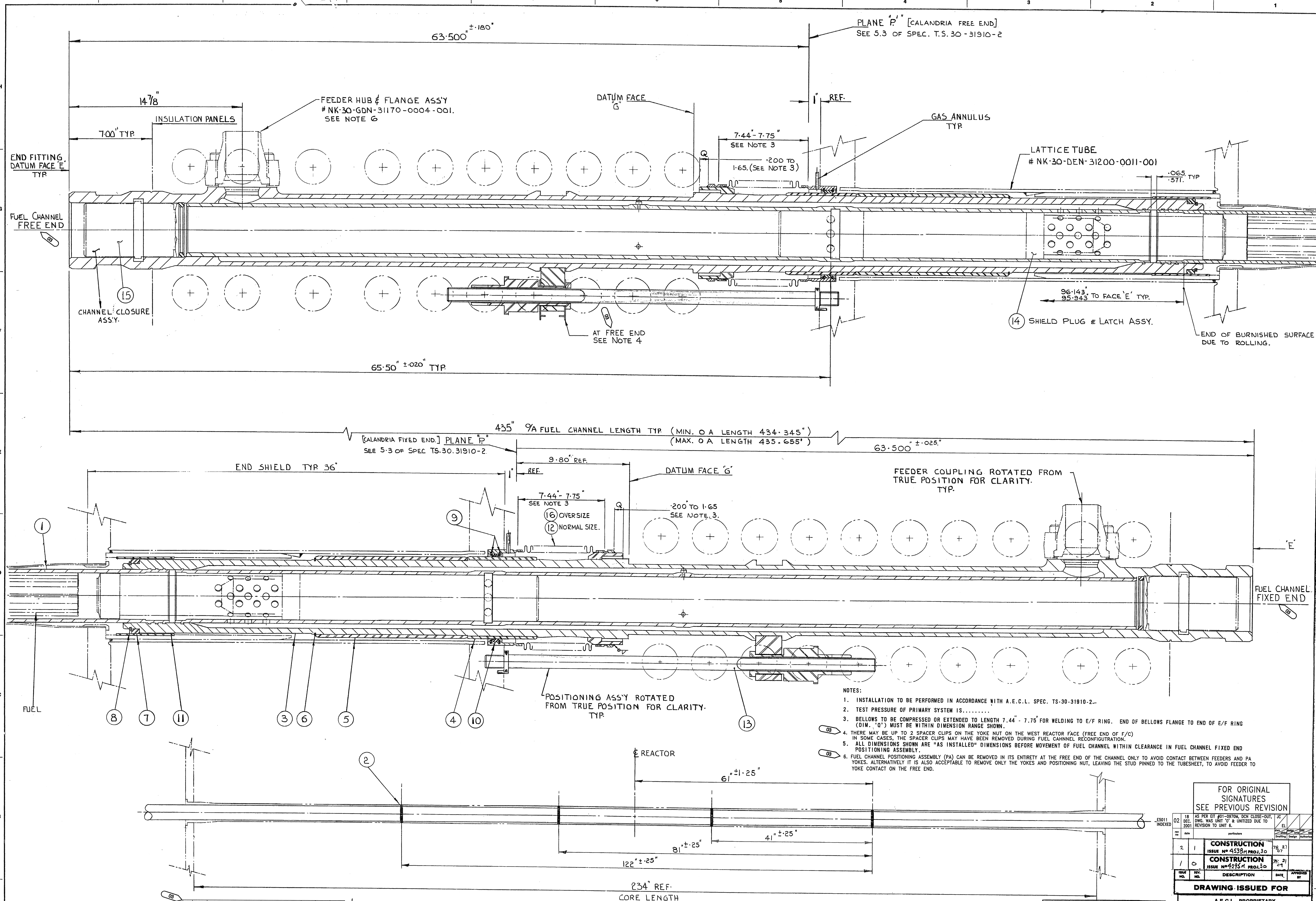
H:\PED-DO\LIB\NK30N\31130\0001S1.MIL

Attachment 3

Fuel Channel Assembly
Major Assembly

NK30-GEN-31100-0004-U5-0001

Total Pages: 2 (including this page)



NOTES:

1. INSTALLATION TO BE PERFORMED IN ACCORDANCE WITH A.E.C.L. SPEC. TS-30-31910-2.
2. TEST PRESSURE OF PRIMARY SYSTEM IS.........
3. BELLOWS TO BE COMPRESSED OR EXTENDED TO LENGTH 7.44" - 7.75" FOR WELDING TO E/F RING. END OF BELLOWS FLANGE TO END OF E/F RING (DIM. 'Q') MUST BE WITHIN DIMENSION RANGE SHOWN.
4. (03) THERE MAY BE UP TO 2 SPACER CLIPS ON THE YOKE NUT ON THE WEST REACTOR FACE (FREE END OF F/C) IN SOME CASES, THE SPACER CLIPS MAY HAVE BEEN REMOVED DURING FUEL CAHNNEL RECONFIGUTRATION.
5. ALL DIMENSIONS SHOWN ARE "AS INSTALLED" DIMENSIONS BEFORE MOVEMENT OF FUEL CHANNEL WITHIN CLEARANCE IN FUEL CHANNEL FIXED END POSITIONING ASSEMBLY.
6. (03) FUEL CHANNEL POSITIONING ASSEMBLY (PA) CAN BE REMOVED IN ITS ENTIRETY AT THE FREE END OF THE CHANNEL ONLY TO AVOID CONTACT BETWEEN FEEDERS AND PA YOKES. ALTERNATIVELY IT IS ALSO ACCEPTABLE TO REMOVE ONLY THE YOKES AND POSITIONING NUT, LEAVING THE STUD PINNED TO THE TUBESHEET, TO AVOID FEEDER TO YOKE CONTACT ON THE FREE END.

FOR ORIGINAL SIGNATURES SEE PREVIOUS REVISION

rev no	date	particulars	dwn / chkd (Drafting)	design / vrfd (Design)	DRE / SM (Authorize)
02	18 DEC. 2001	AS PER EIT #01-0970M, DCN CLOSE-OUT, DWG. WAS UNIT '0' & UNITIZED DUE TO REVISION TO UNIT 6.	JC / EL		

E5011 INDEXED

ISSUE NO.	REV. NO.	DESCRIPTION	DATE	APPROVED BY
2	1	CONSTRUCTION ISSUE Nº 4538M PROJ. 30	78 07 27	
1	0	CONSTRUCTION ISSUE Nº 4295M PROJ. 30	75 09 21	

DRAWING ISSUED FOR

A.E.C.L. PROPRIETARY

rev no	date	particulars	dwn / chkd (Drafting)	designed / verified (Engineering)	approved
03	13 April 2005	NOTE 6 ADDED. DRAWING ISSUED FOR EC28226 CLOSE-OUT TO REFLECT AS BUILT CONDITIONS.	RS		

INDEXED

No.	DATE	REVISION	LOC.	BY	APP'D
1	78-07-26	9.80 ±.050 DELETED	H-5	BHT	78-07-26
↓		9.80 REF WAS 9.80 ±.050	E-7	↓	↓
↓		(MAX O.A. LENGTH 435.655") - ADDED	E-5	↓	↓

No.	REFERENCES	DRAWING NO.

FOR BILL OF MATERIAL
SEE BM. NK30-MAN-31100-0004-U5 (02) E0650
SHEET 1 OF 2 SHEETS.

DRAWING TRANSFERRED TO ONTARIO HYDRO AT REV. NO. 01 DATE 18 Jan 89

ATOMIC ENERGY OF CANADA LIMITED
Power Projects, Sheridan Park Research Community
Mississauga, Ontario L5K 1B2

DRAWN A. TEREPORA APRIL 15-75 CHECKED BHT 78-04-19
DESIGNED
APPROVED 16-4-75
SCALE 3/8" = 1" & 1/8" = 1"

PICKERING G.S. 'B' UNIT 5

FUEL CHANNEL ASSEMBLY MAJOR ASSEMBLY.

NK30-GEN-31100-0004-U5-0001 REV 03

Attachment 4 to OPG Letter, J. Franke to M. Leblanc and A. Viktorov, “Pickering NGS: OPG responses to CNSC staff inquiries related to OPG’s request for expedited authorization to restart following the Pickering Unit 5 2021 fall forced outage”, CD# NK30-CORR-00531-08334.

OPG Responses to CNSC Questions regarding OPG’s October 1st Request for Expedited Authorization to Restart Following Pickering Unit 5 2021 Fall Forced Outage

CNSC Question 1:

Based on the Figure 1 from N-CORR-31100-0953933, there are 3 dispositionable flaws (P6N04-IND 4, 6 and 9) in close proximity to each other and seems to be close to the fuel end plate. OPG is requested to clarify whether these flaws formed due to a specific issue (e.g. fuel bundle damage)? It seems that there are no similar flaws after 2001, has the issue been already addressed?

OPG Response to CNSC Question 1:

OPG has reviewed our fuel inspection history and there were elevated Iodine levels in the unit in 2001, however OPG was not able to find any conclusive evidence that it was from fuel in channel N04. Note that these flaws are at the end of the last fuel bundle. They have been assessed and have been dispositioned fit for service to end of life, even at increased Heq concentrations.

CNSC Question 2:

Did OPG inspect the fuel and fuel bundle as part of evaluation of those three Unit 6 flaws detected in 2001? Was any damage identified?

OPG Response to CNSC Question 2:

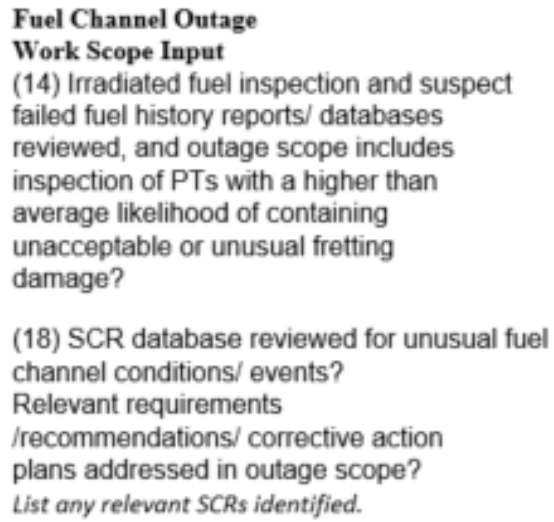
There was no record found that fuel bundles were inspected from P6N04 during this time.

CNSC Question 3:

Does OPG regularly inspect a channel after detecting a fuel bundle damage? Is there any internal OPG procedure that calls for such an inspection?

OPG Response to CNSC Question 3:

Yes, OPG takes into consideration inspections of pressure tubes where fuel damage has occurred. The fuel channel program incorporates feedback from defects detected (via Inspections and Iodine spikes) by the fuel inspection program as an input to pressure tube inspections. This also includes a review of the SCR database and the fuel inspection database as shown under item 14 and 18 in Appendix A (shown below) of our scope of work documents. This appendix is an input into the preparation of our SOW documents to determine inspection requirements during upcoming outages. This is governed by our Major Component – Outage Scope Management Procedure N-PROC-MA-0036.



Fuel Channel Outage
Work Scope Input
(14) Irradiated fuel inspection and suspect failed fuel history reports/ databases reviewed, and outage scope includes inspection of PTs with a higher than average likelihood of containing unacceptable or unusual fretting damage?

(18) SCR database reviewed for unusual fuel channel conditions/ events? Relevant requirements /recommendations/ corrective action plans addressed in outage scope?
List any relevant SCRs identified.

CNSC Question 4:

Staff understand that the shield plug covers the location of P5O05- IND 1 flaw. If this is correct, OPG is requested to clarify how can a debris get struck between the shield plug and Pressure tube and formed a flaw? What is the typical gap between the shield plug and pressure tube?

OPG Response to CNSC Question 4:

Yes, the shield plug does cover this location. It is possible that this flaw is a scratch that was formed due to debris stuck in fuel bundles during fuelling operations or in a rare occurrence, early in life where a potential debris was caught in the shield plug. However, the clearance between the shield plug and the pressure tube is very minimal. Note that the actual cause of this flaw (i.e. scratch or debris) cannot be confirmed, however for the purposes of pressure tube fitness for service, it has been assessed conservatively as a debris fret. There is a very low likelihood of debris flaws forming in this region as the last fuel bundle rests against the outlet shield plug, which resides nominally ~85 mm inboard of the burnish mark. OPG has a robust Foreign Material Exclusion (FME) program which is demonstrated by the low number of debris fretting in our units

CNSC Question 5:

OPG noted that when fuel with entrained debris interacts with the bottom of the pressure tube during fueling, it is possible for flaws to form; however during fueling, a bundle is not expected to be left in a given axial position for long enough time to form a flaw (except due to unique situations). OPG is requested to clarify whether their evaluations indicated abnormal fuel loading times in those channels prior to the detection of the flaws.

OPG Response to CNSC Question 5:

Foreign material or debris can sometimes move through the channel during the fuelling operation and can get caught within the fuel bundle eventually residing between the fuel and pressure tube (i.e. inboard of the region of interest). It can remain there for some period of time eventually causing a debris fret in the lower portion of the pressure tube. However, as demonstrated by the low number of debris frets and fuel defects in OPG units, OPG has a robust FME program.