Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

CMD 26-H7.45A

Date: 2026-09-21

Supplementary Information

Renseignements supplémentaires

Presentation from Prolet Inc.

Présentation de Prolet Inc.

In the matter of

À l'égard de

Ontario Power Generation

Ontario Power Generation

Application to refurbish Pickering Nuclear Generating Station and to renew licences for the Pickering Nuclear Generating Station and Waste Management Facility

Demande concernant la réfection de la centrale nucléaire de Pickering et le renouvellement de ses permis pour la centrale et l'installation de gestion des déchets

Commission Public Hearing
Part 2

Audience publique de la Commission
Partie 2

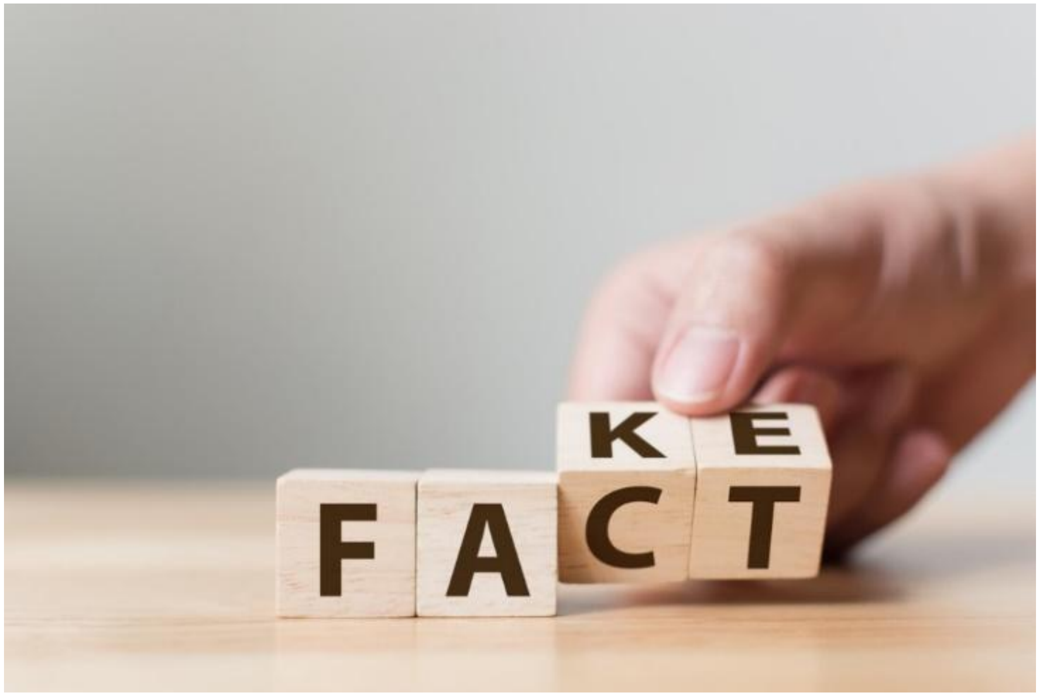
October 6-9, 2026

6-9 octobre 2026

Document ID: QQQVZZNDK725-166150894-14961

Canada

$26.7 Billion to 'refurbish' PICKERING B CANDU REACTORS that were deemed unfit for refurbishment 10 years ago by OPG Board



Sunil Nijhawan, Ph.d. P.Eng

For presentation at CNSC public meeting on 7 October 2026

OPG REQUEST BASED ON AN UNTRUE BENEFITS CLAIM

CLAIM in CMS26-H-&-OPG-APP-REN page iv

The refurbishment of Pickering NGS Units 5 to 8 will provide many benefits for customers, the economy, and the environment including:

- Securing more than 2,100 MW of clean, reliable nuclear power for Ontario for an additional 30-plus years.

REALITY :

1. A refurbishment never has and never will reset the reactor to generate full design power.
2. For the last 7 years, since hourly power output data is available fromOntario's Independent Electricity System Operator IESO,:

   - The stated claim was false for over 99.11 % of the time.
   - Station produced more than 2100 MW to for only 0.9% of the time.
   - The average power output was 1670.48 MW, and
   - The Station produced less than this average power 59% of the time.

THESE HEARINGS ARE PREMATURE

As a minimum one expects CNSC to require OPG to disclose to all:

- The complete 2010 Pickering B refurbishment business case, closure report and lessons-learned/root-cause analysis;
- A line-by-line reconciliation of the 2010 and current conclusions;
- Sunk costs separately from future committed and forecast costs;
- Unit-by-unit and common-system cost contingencies;
- Uncertainty ranges rather than a single point estimate;
- The economic effect of one-, two-, three- and five-year schedule delays;
- The assumed post-refurbishment capacity factor and forced-outage rate;
- Experience-based comparisons with Point Lepreau, Wolsong-1, Gentilly-2 , Darlington and Bruce;
- Experience-based comparisons with other power generation options
- The disposition of every safety-significant component not included in the replacement scope;
- Disposition of design errors and vulnerability claims by external experts
- independent assessment of concrete, containment, vacuum-building and shared-system ageing;
- evidence that the project remains justified if additional post-Fukushima or severe-accident upgrades are required.
- Evidence that it has not misrepresented the risk from a sustained loss of electrical power – a station blackout.

BENEFITS TO ONTARIO WILL BE DWARFED BY RISK PROFILE

OPG does not have the technical acumen or a management team to direct a proper risk assessment and have made public risk related claims that are fundamentally false. There have been no design improvements and recognition of lessons learnt by the world about reactor safety and honesty in matters nuclear have all been ignored.

DESIGN VULNERABILITIES THAT PRECLUDE FURTHER OPERATION

1. *Containment 500 times leakier and 10 times weaker in than normal PWRs and unable to handle a severe accident in more than one inter-connected units*
2. *Current primary cooling system overpressure protection design inherently forces a reactor damage even before an ECC loss leading to severe core damage.*
3. *No provisions for manual depressurization of primary circuit after a sustained loss of power. No super high pressure ECC or makeup intervention / injection.*
4. *Onset of a severe core damage puts activity and combustible gases directly into the relatively weak containment in 3-4 hours. There is no holding of activity in a vessel like in a PWR pressure vessel.*
5. *Significantly higher sources of "hydrogen" from large amounts of carbon steel in feeders and Zircaloy in fuel sheaths and pressure tubes / Calandria tubes.*
6. *The limited number of 'hydrogen' recombiners will cause explosions.*
7. *Enhanced potential for energetic interactions of melting fuel with enveloping water*
8. *Pressure relief in ALL relevant reactor systems is inadequate and contrary to safe operation requirements(PHTS, Calandria, Shield Tank, Containment)*
9. *The containment amongst the weakest in the world for pressurization (~0.5 Atm);*
10. *The Calandria Vessel, long heralded as a core catcher, is a thin ~1" thick stainless steel welded low pressure vessel that has been assessed to fail catastrophically at welds and not able to contain hot molten debris.*

Another Eleven vulnerabilities

11. *This Calandria vessel failure can not only lead to enhanced combustible gas production but also severe energetic explosions leading to failure of structures*
12. *Current Shield Tank cannot contain pressure upon boiling and can fail. Restoration of cooling after water depletion problematic.*
13. *Inadequate instrumentation and control after a severe accident.*
14. *Poor equipment survivability as severe accident environments very unfavorable due to a lack of containing pressure vessel*
15. *Currently installed PARS inadequate and potentially dangerous.*
16. *No dedicated operator training / simulators for severe accidents.*
17. *Severe accident simulation methods are outdated, crude and inadequate.*
18. *No significant design changes implemented. Known problems ignored.*
19. *Current SAMGs are inadequate. Many Emergency hookups not implemented.*
20. *High risk potential from external events*
21. *Need to reconsider malevolent actions and sabotage at spent fuel storage pools as well.*

SAFE NUCLEAR

OPPORTUNITIES FOR DESIGN IMPROVEMENT

1. Reduce likelihood of fuelling machine adversely affecting the outcome upon restoration of cooling functions
2. Modify Calandria vessel overpressure system to avoid fluid loss through rupture disks; delay onset of severe core damage
3. Modify moderator cooling system to install recovery system hookups for inventory replenishment and reinstatement of cooling functions
4. Investigate potential of in-situ design enhancements to avoid Calandria vessel failure by hot debris to avoid catastrophic failure of reactor structures
5. Increase the likelihood of successful external water injection by manual depressurization of the heat transport system
6. Increase the likelihood of core inventory degradation by ultra high pressure water addition to pressurized HTS before core degradation and prior to an in-core rupture
7. Increase the likelihood of reactor heat transport system heat removal by thermo-syphoning by adding systems to remove non condensable gases that can degrade thermo-syphoning

More OPPORTUNITIES FOR DESIGN IMPROVEMENT

8. Evaluate and document the effect of recovery actions including power restoration, water injection as a function of time since onset of core damage
9. Install additional and independent of that available before Fukushima, instrumentation to detect and help control the progression of a severe core damage accident
10. Reduce likelihood of recovery actions exasperating the accident consequences by enhanced severe accident specific instrumentation and display of state of the reactor
11. Reduce likelihood of fuelling machine adversely affecting the outcome upon restoration of cooling functions
12. Modify Calandria vessel overpressure system to avoid fluid loss through rupture disks; delay onset of severe core damage
13. Modify moderator cooling system to install recovery system hookups for inventory replenishment and reinstatement of cooling functions
14. Investigate potential of in-situ design enhancements to avoid Calandria vessel failure by hot debris to avoid catastrophic failure of reactor structures
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16. Increase the likelihood of core inventory degradation by ultra high pressure water addition to pressurized HTS before core degradation and prior to an in-core rupture

More OPPORTUNITIES FOR DESIGN IMPROVEMENT

17. Increase the likelihood of reactor heat transport system heat removal by thermosyphoning by adding systems to remove non condensable gases that can degrade thermosyphoning.
18. Reduce the *likelihood* of ECC injection failure
19. Modify shield tank over pressure protection system to conform to anticipated heat loads to avoid catastrophic failure of shield tank vessel.
20. Install hookups for water addition to the shield tank
21. Consider alternate hydrogen mitigation measures as PARS may become ignition sources; consider upgraded catalyst plates with electrolytic deposition that limit gas temperatures.
22. Installation of measures to avoid ignition in existing PARS
23. Consider D_2 mitigation system optimization for a 100% Zircaloy oxidation (also to include effect of feeder oxidation)
24. Consider enhanced deuterium concentration monitoring systems within containment and Calandria vessel
25. Consider advanced video surveillance systems
26. Consider measures for mitigation of consequential fires during the progression of core disassembly
27. Consider post accident monitoring system instrumentation and control survival and functionality for severe accident conditions
28. Consider emergency filtered containment venting for severe accident loads

More Opportunities to improve an old design

29. Consider emergency filtered containment venting for severe accident loads
30. Consider improvements to pressure suppression system in reactor building as the vacuum building may be inadequate to avoid building failure for multi unit accidents
31. Consider reactor building reinforcements to avoid building failure; special emphasis on confinement on top of reactivity decks in multi unit station
32. Consider deploying on-site and off-site radiation detection equipment that actually detects the source characteristics and differentiates between incident radiation species by measuring the energy of incident radiation; does not get saturated by incident particulates as happened for Chernobyl at Leningrad station a thousand km away.
33. Develop methods and acquire instrumentation to help deduce source terms from radiation measurements so that prediction of radiation effects can be made for different locations and changing weather conditions
34. Develop simulators to train the operators in progression of a severe core damage accident and develop experimental basis & analysis to help avoid potential adverse outcomes of various mitigation measures

LONG SUGGESTED CRITICAL ISSUES

1. *This Calandria vessel failure can not only lead to enhanced combustible gas production but also severe energetic explosions leading to failure of structures*
2. *Current Shield Tank cannot contain pressure upon boiling and can fail. Restoration of cooling after water depletion problematic.*
3. *Inadequate instrumentation and control after a severe accident.*
4. *Poor equipment survivability as severe accident environments very unfavorable due to a lack of containing pressure vessel*
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11. *Need to reconsider malevolent actions and sabotage at spent fuel storage pools as well.*

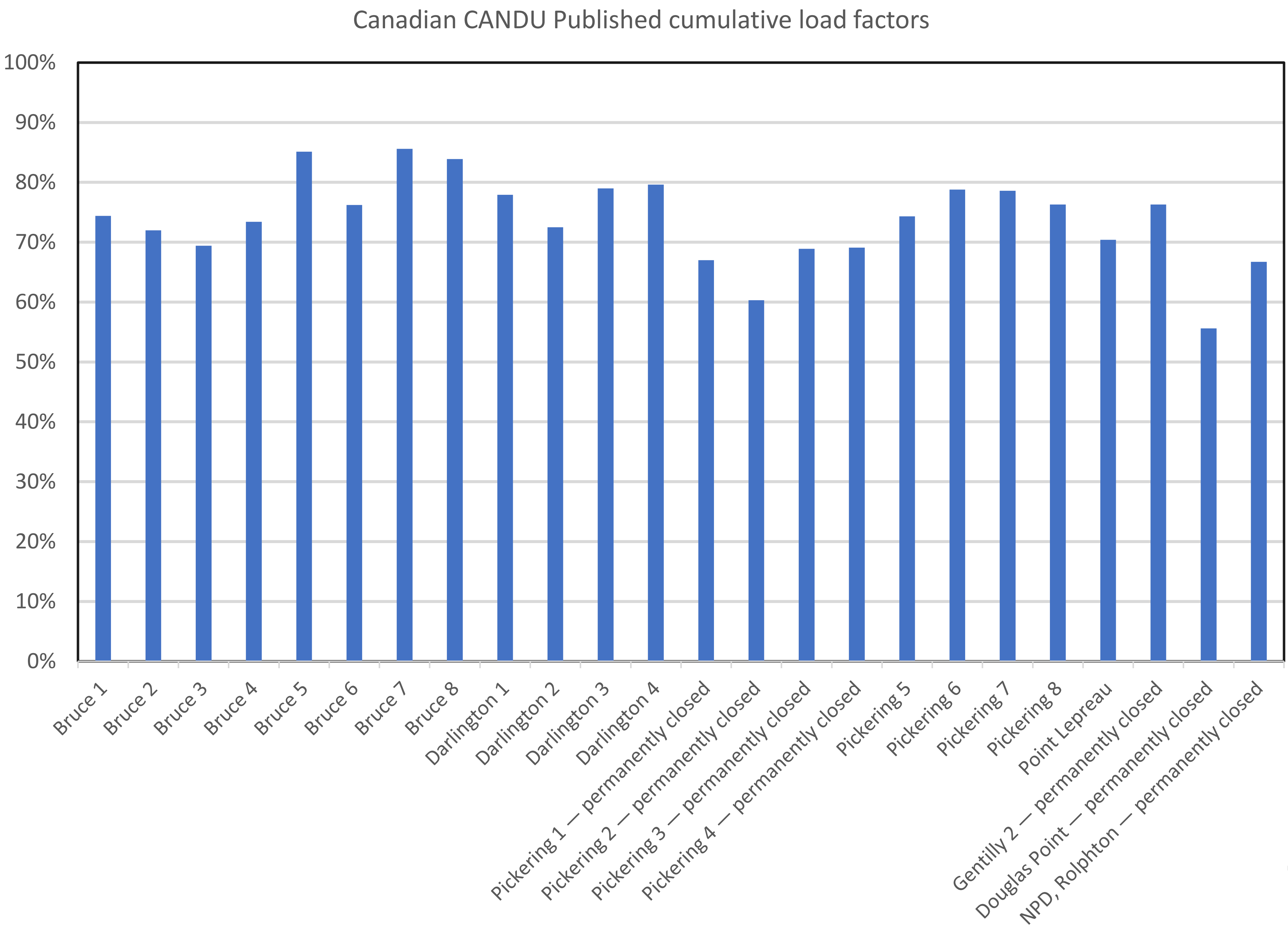
PICKERING B TIMETINE

Unit	First major concrete	First criticality	First grid connection	Commercial operation
Pickering 5	01-Nov-74	**23-Oct-82**	19-Dec-82	10-May-83
Pickering 6	01-Oct-75	**15-Oct-83**	08-Nov-83	01-Feb-84
Pickering 7	01-Mar-76	**22-Oct-84**	17-Nov-84	01-Jan-85
Pickering 8	01-Sep-76	**17-Dec-85**	21-Jan-86	28-Feb-86

Refurbishment does not reset the age of the structures, components and systems on which reactor safety depends.

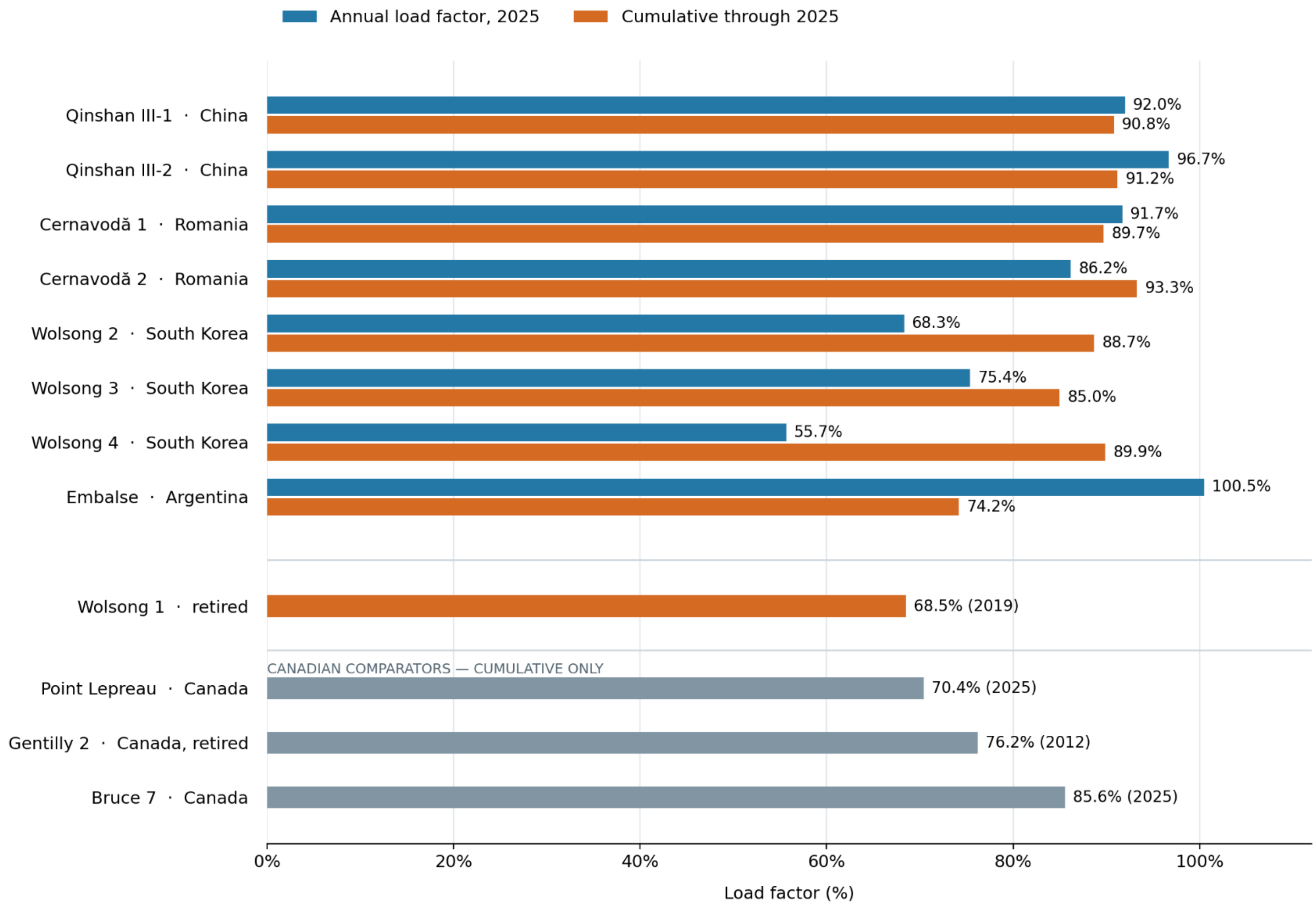
Commercial and post-retirement consulting career interests not-withstanding, CNSC members and staff have no right to play with nation's destiny.

CANDU HISTORIC LOAD FACTORS IN CANADA



Canadian-designed CANDUs abroad

Annual output performance and published cumulative load factors



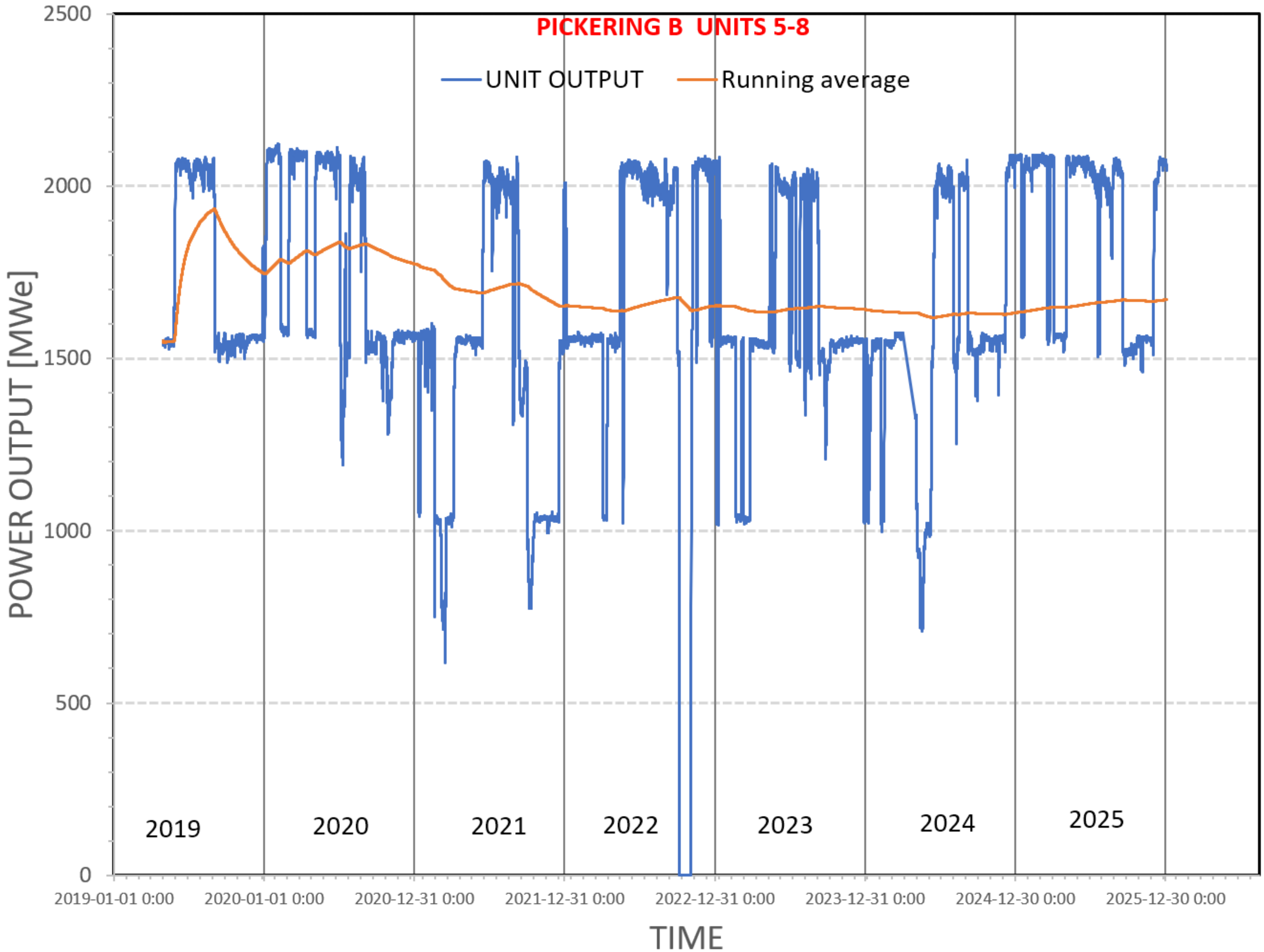
Cumulative factors follow the source reporting basis and may exclude suspended-operation periods.
Different operating ages and refurbishment histories limit direct lifetime comparisons. Wolsong 1 has no 2025 annual value.

Source: World Nuclear Association reactor histories, citing IAEA PRIS; values from the preceding comparison.
world-nuclear.org/nuclear-reactor-database/details/[reactor-name] • Retrieved 18 September 2026

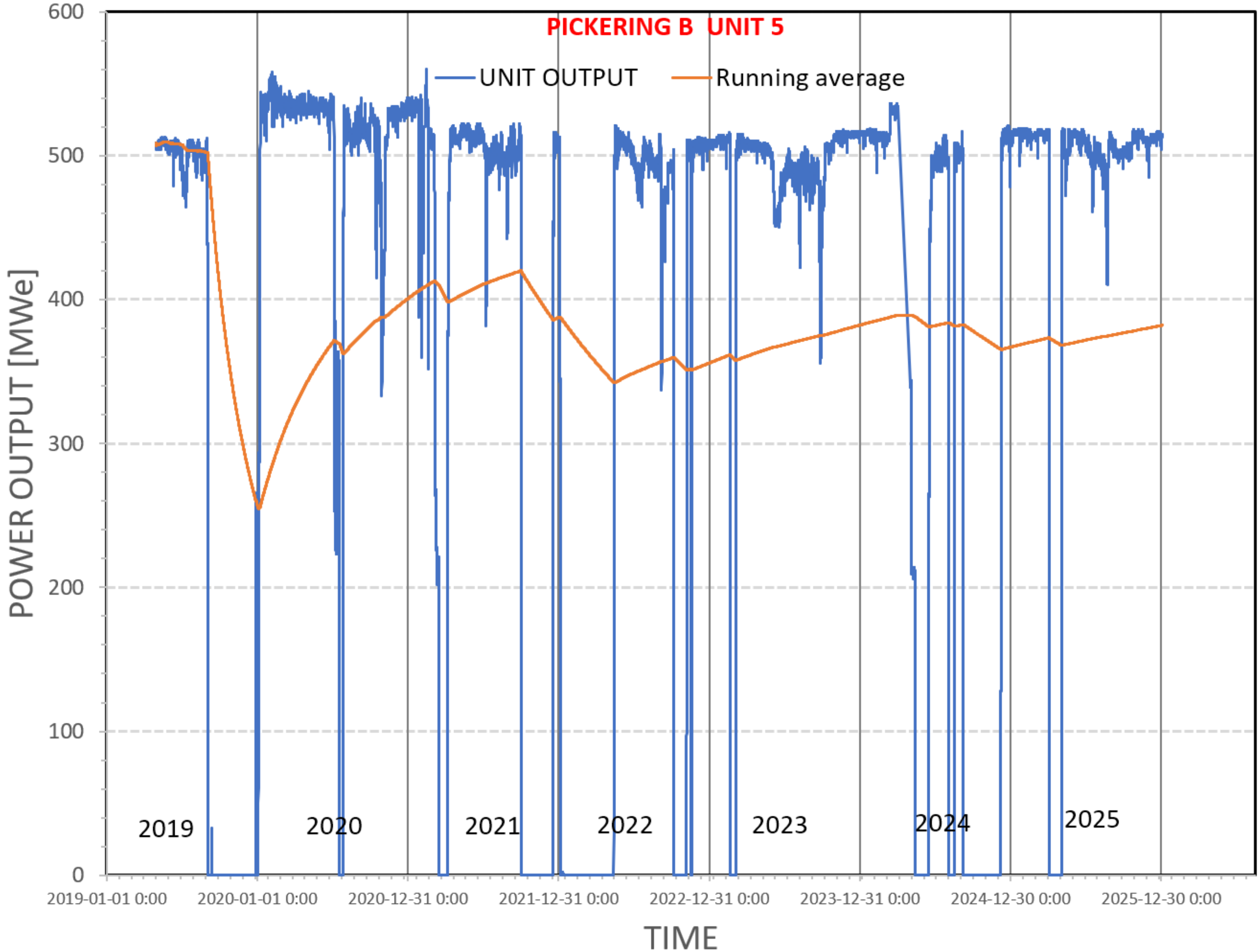
PICKERING STATION OUTPUT STATS

	UNIT 5	UNIT6	UNIT 7	UNIT 8	STATION
TOTAL DATA 57756 hours					
ZERO POWER HOURs	13569	9003	8639	9368	655
	23.5%	15.6%	15.0%	16.2%	
HOURS ABOVE 500 MW	33020	41958	46018	41155	18751
	57.2%	72.6%	79.7%	71.3%	32.5%
HOURS ABOVE 400 MW	42515	47930	48665	47442	23878
	73.6%	83.0%	84.3%	82.1%	41.3%
HOURS ABOVE 300 MW	43103	48384	48750	47640	51630
	74.6%	83.8%	84.4%	82.5%	89.4%
<260 MW POWER HOURs	14392	9208	8841	10015	
	24.9%	15.9%	15.3%	17.3%	
<100 MW POWER HOURs	13757	9114	8725	9534	
	23.8%	15.8%	15.1%	16.5%	

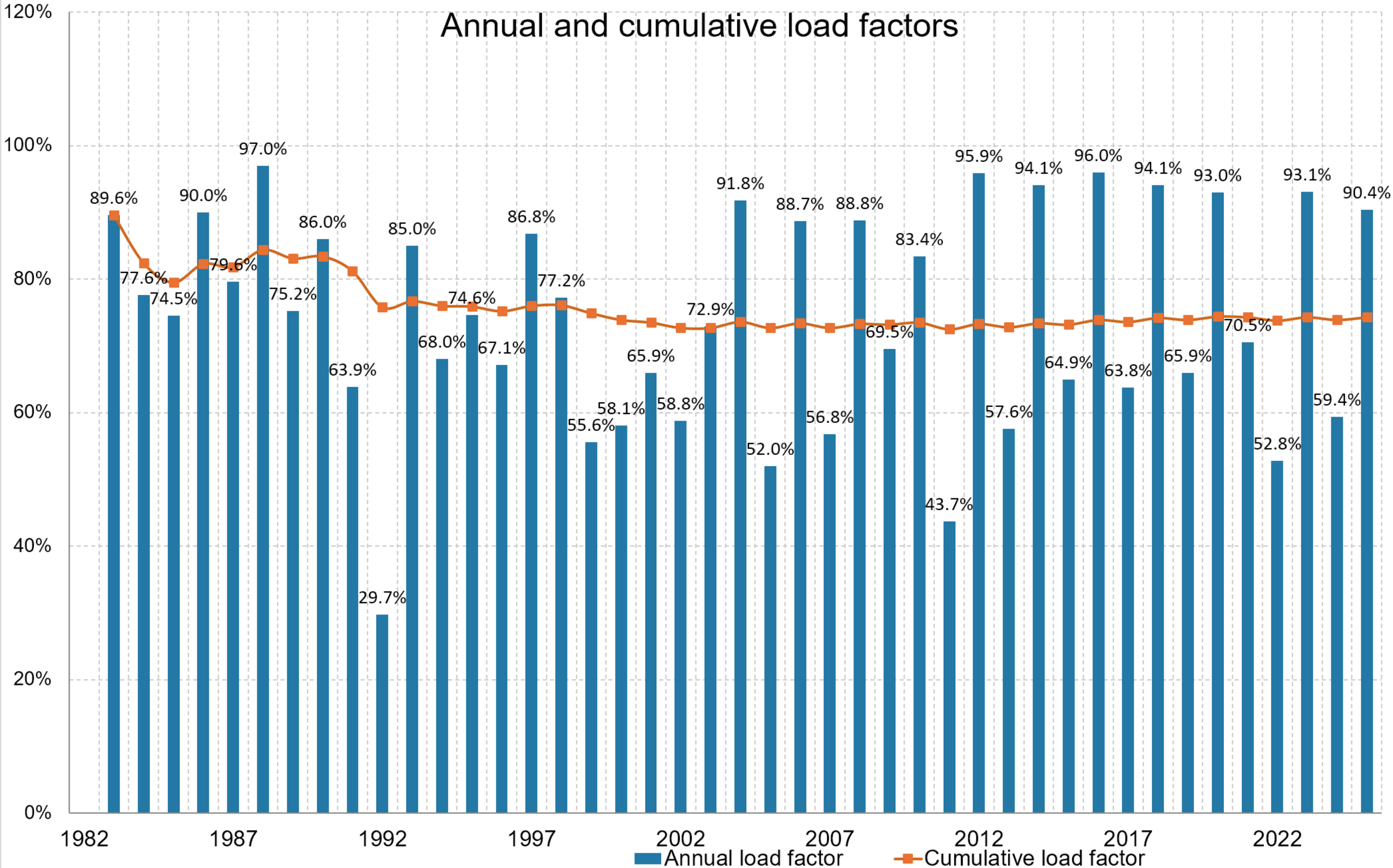
PICKERING B HOURLY DATA FOR LAST 7 YEARS



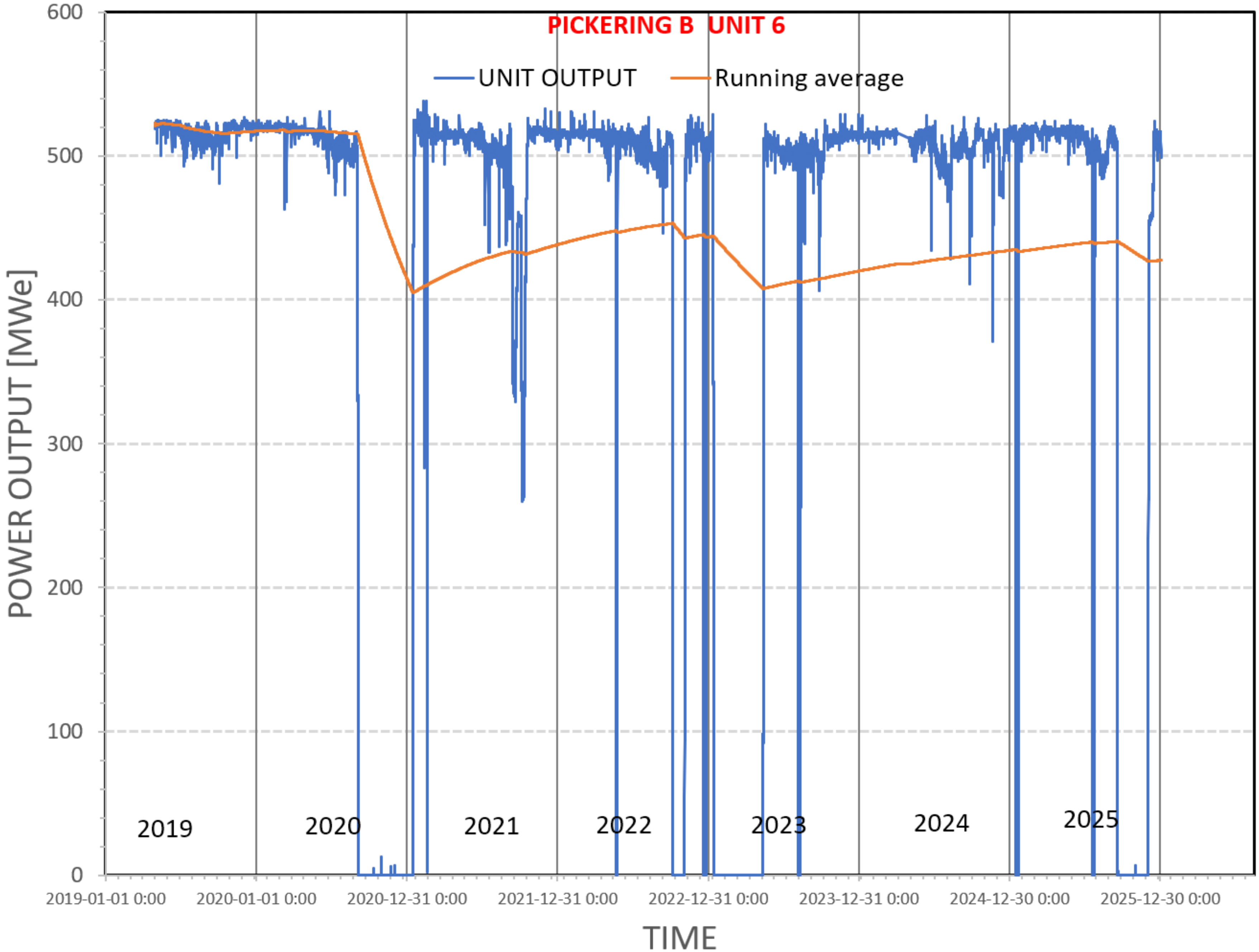
PICKERING UNIT 5 – HOURLY FOR 7 YEARS



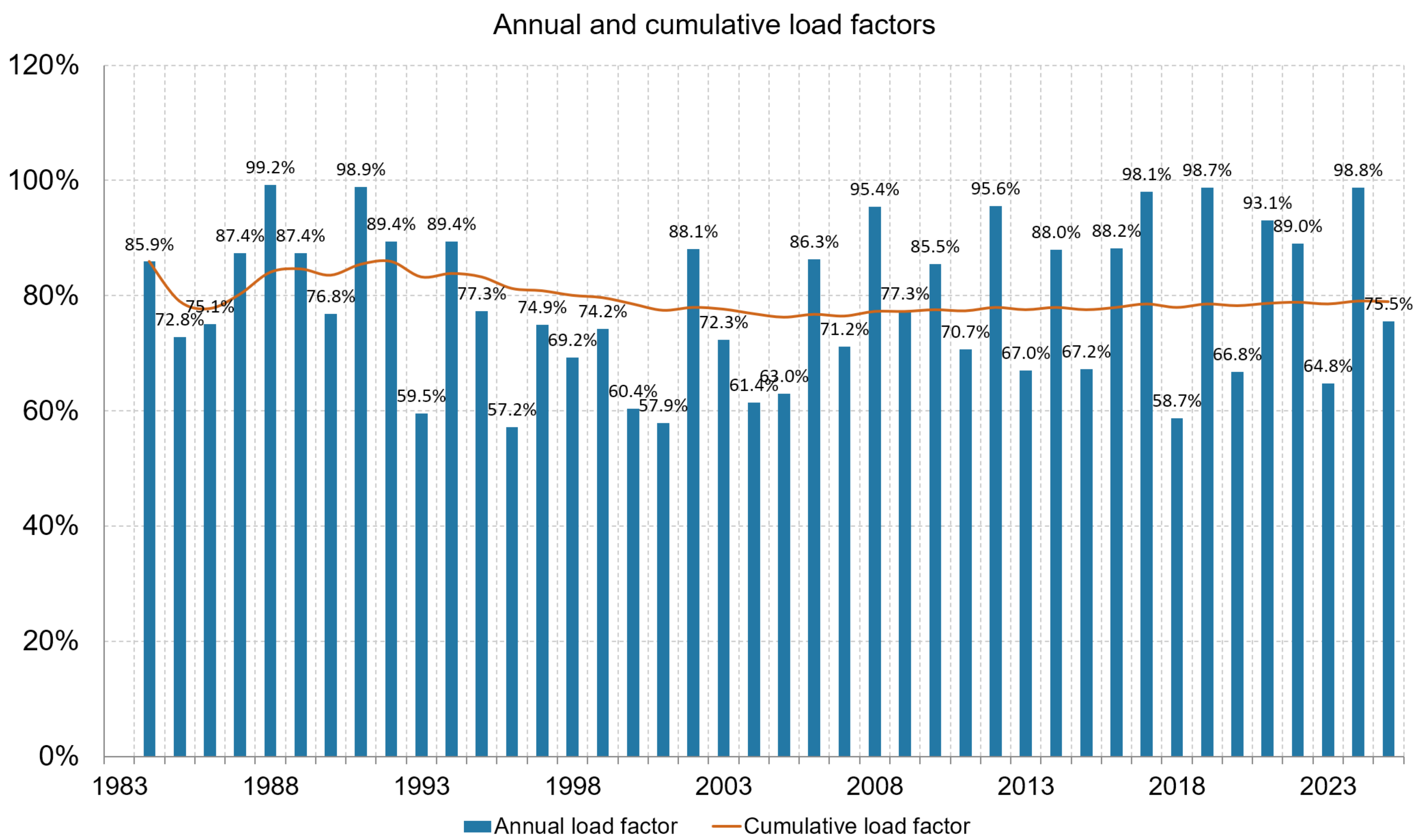
PICKERING UNIT 5 – YEARLY FOR 39 YEARS



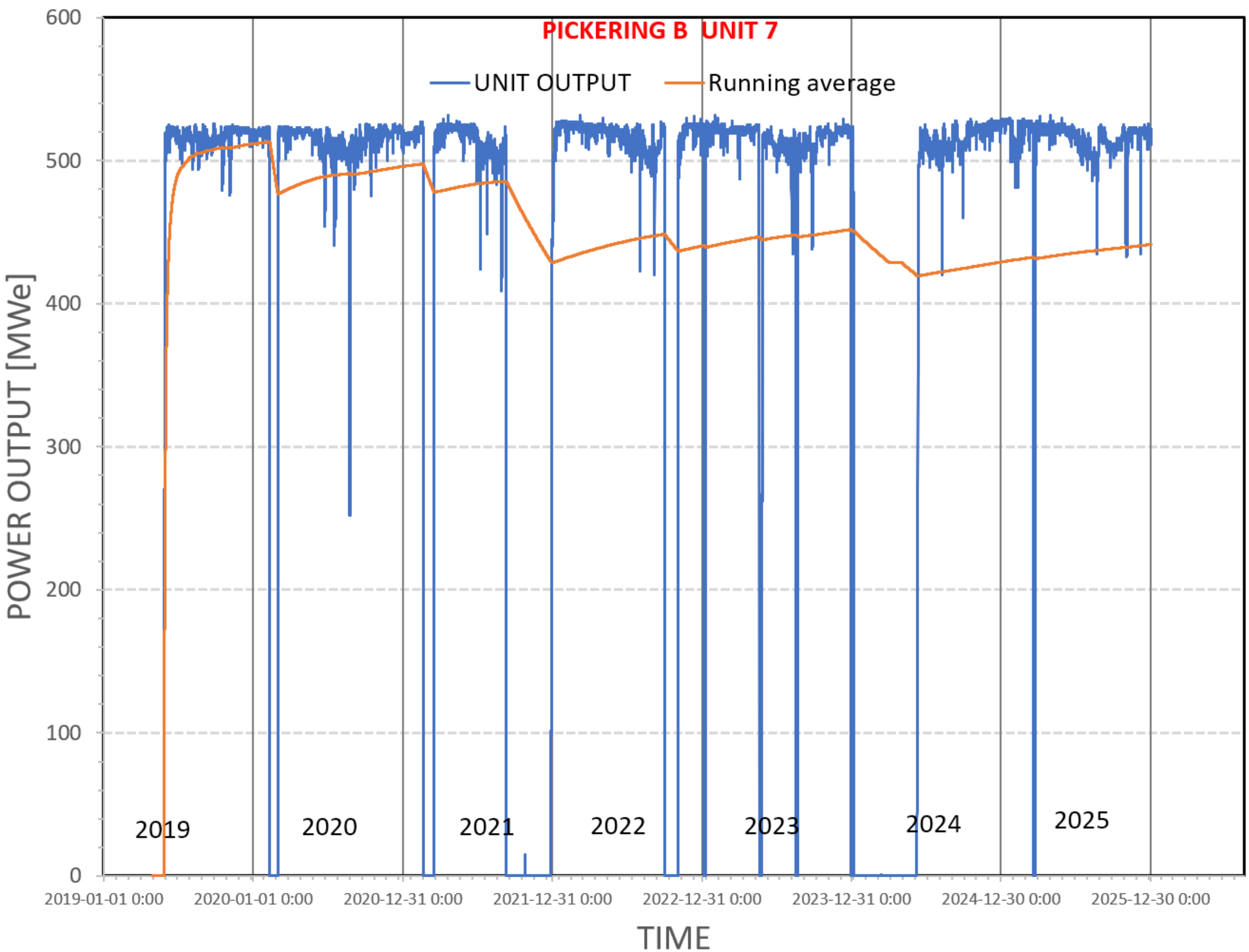
PICKERING UNIT 6



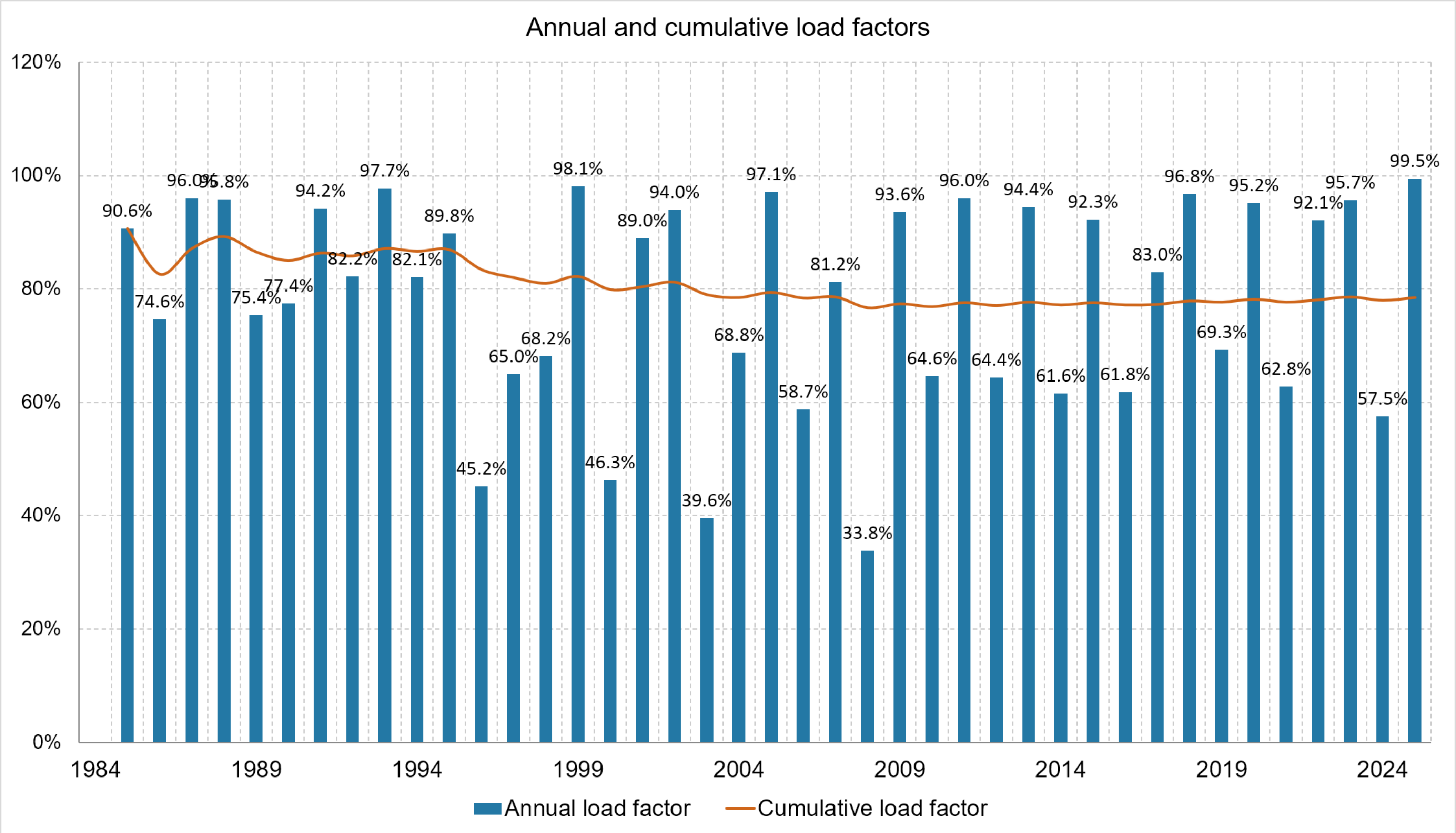
PICKERING UNIT 6 FOR LAST 40 YEARS



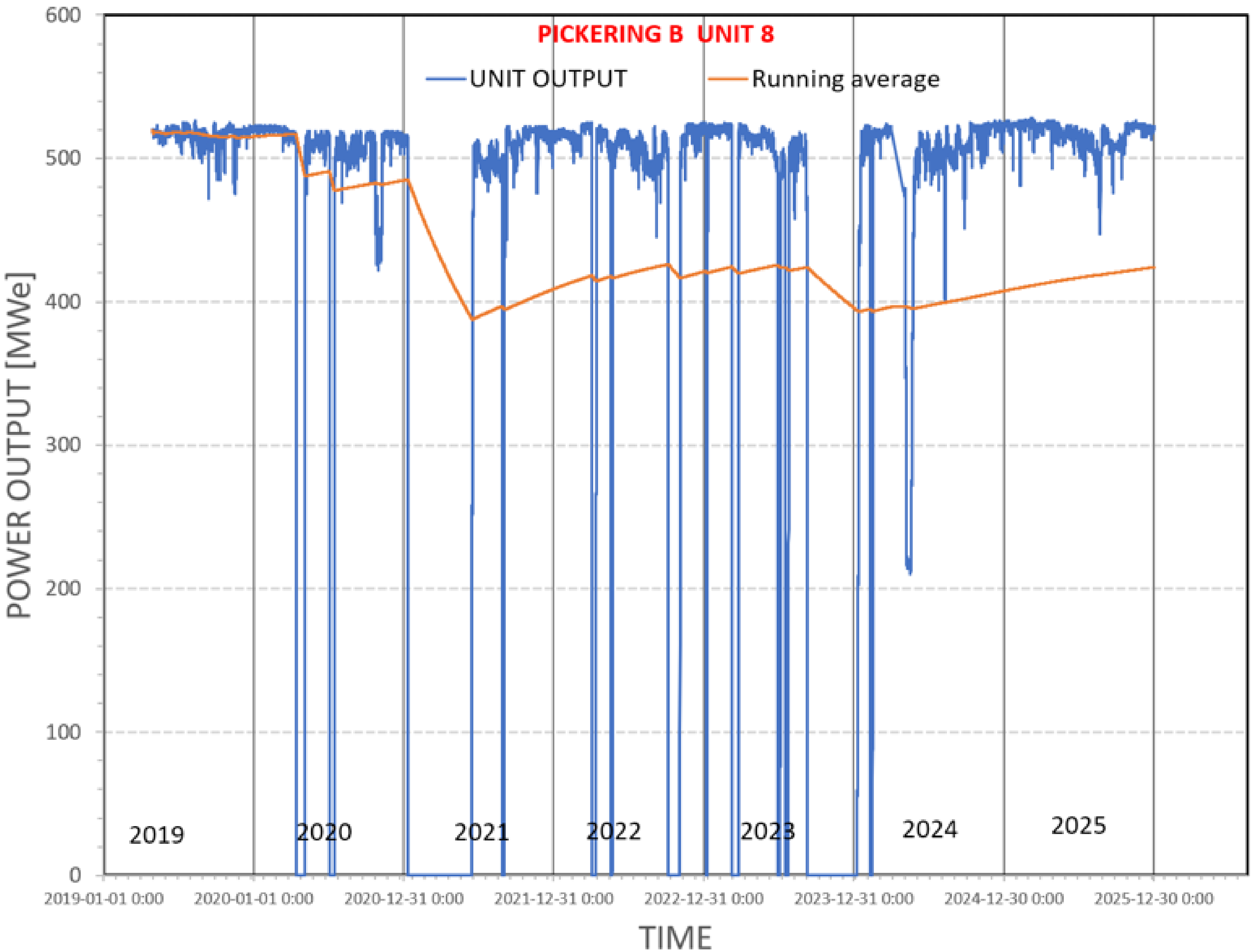
PICKERING UNIT 7 – HOURLY FOR LAST 7 YEARS



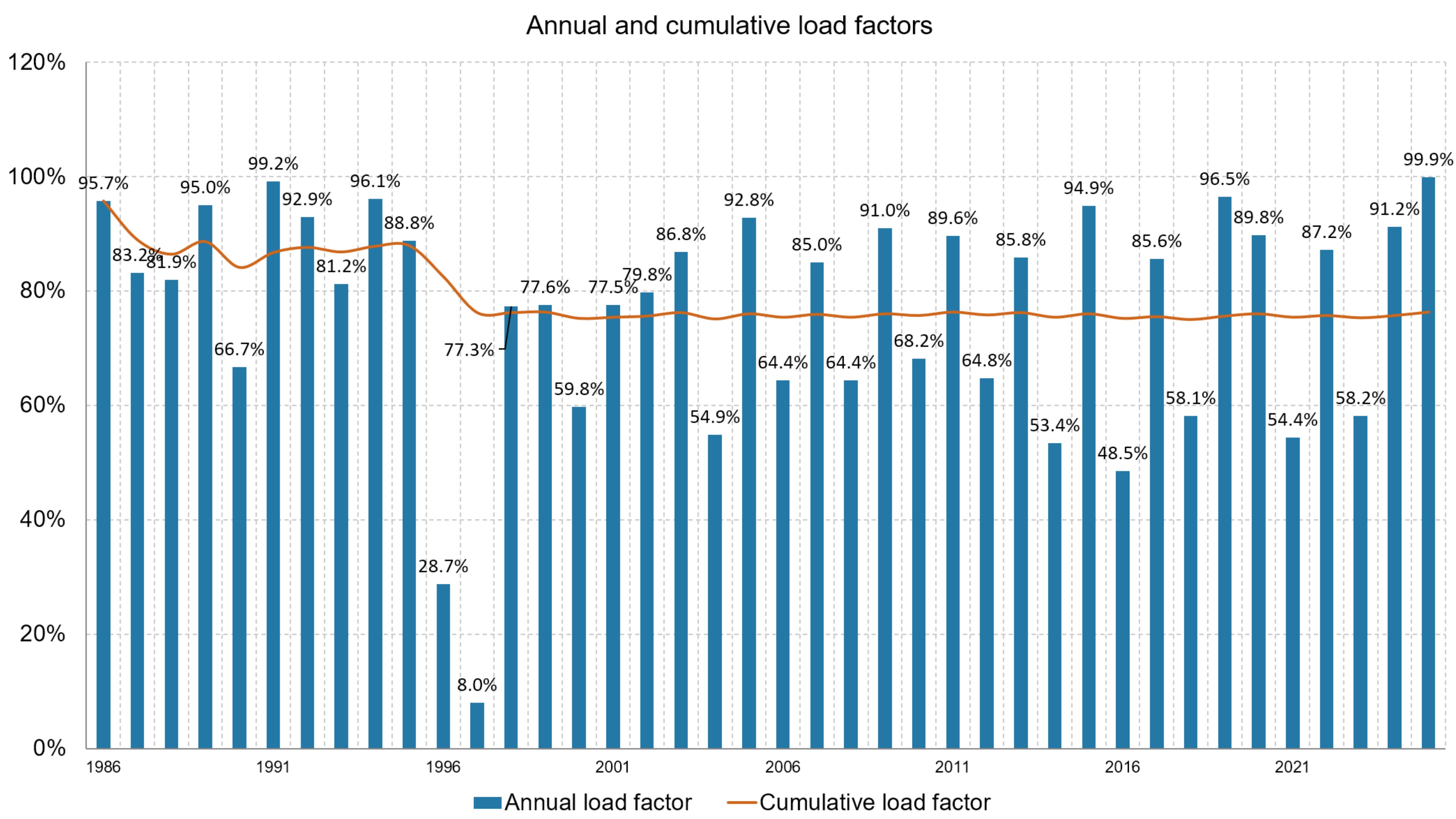
PICKERING UNIT 7 FOR LAST 41 YEARS

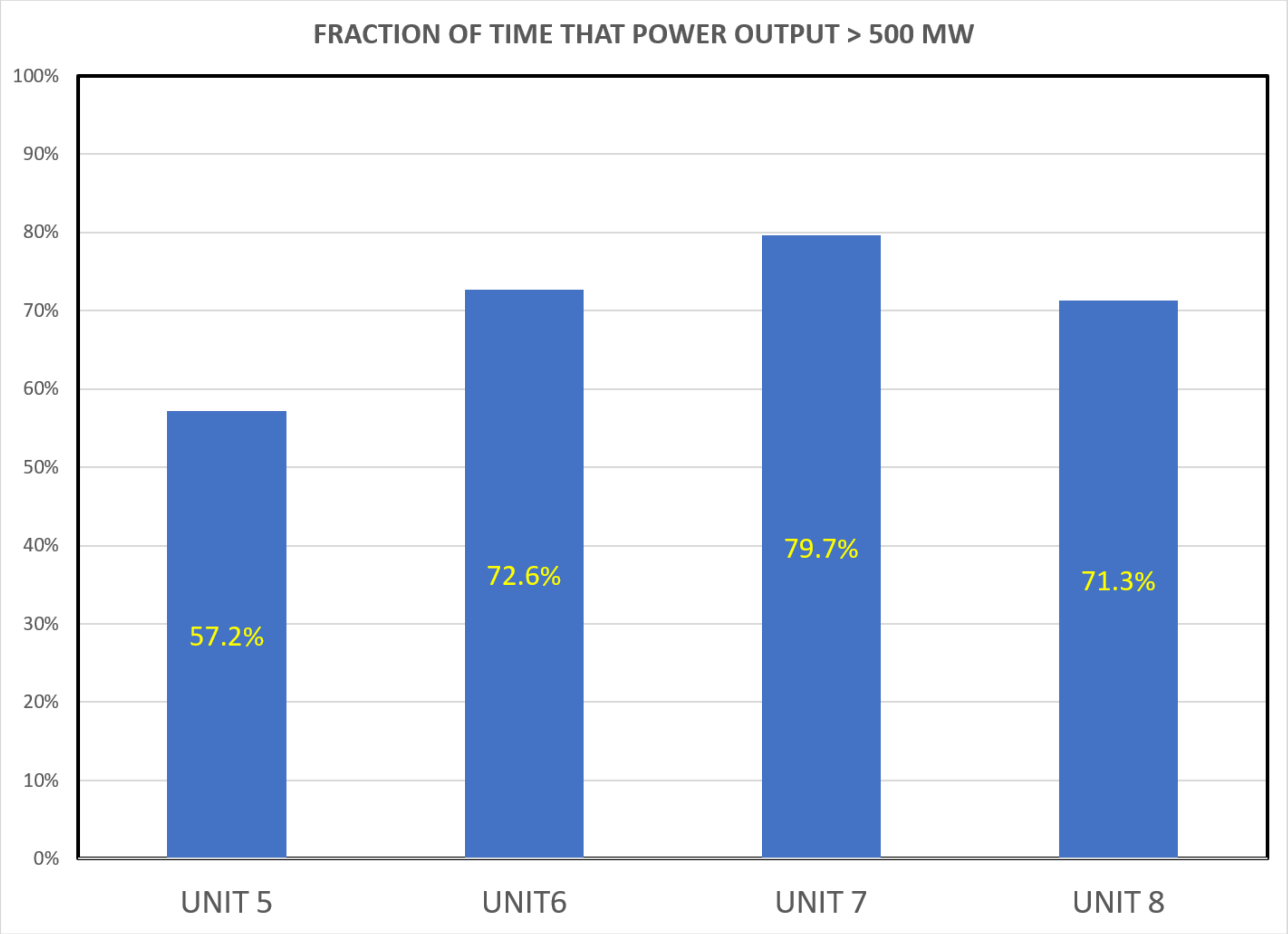


PICKERING UNIT 8 – HOURLY FOR LAST 7 YEARS



PICKERING UNIT 8 – YEARLY FOR LAST 40 YEARS

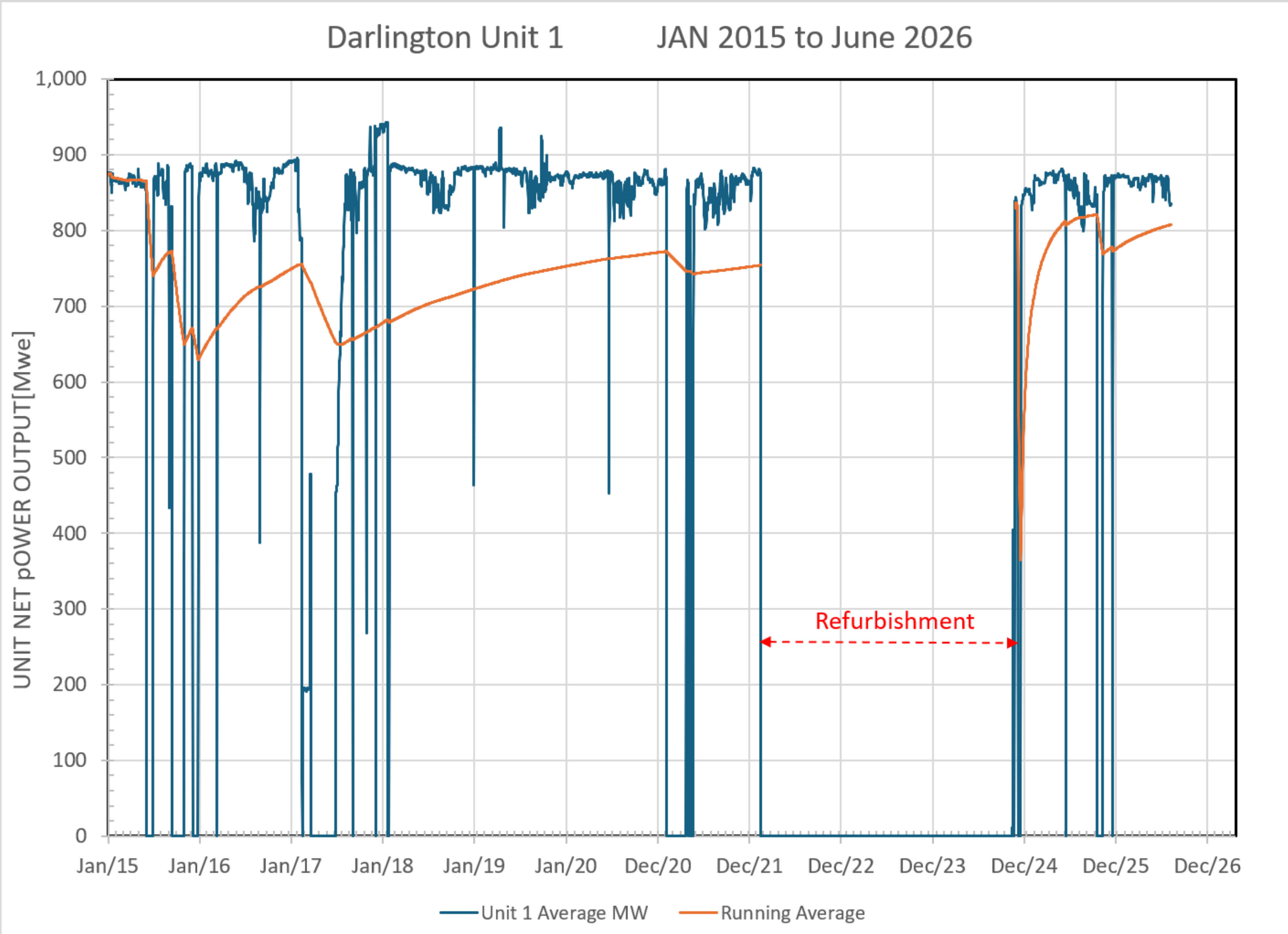



FRACTION OF TIME THAT POWER OUTPUT > 500 MW
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
57.2%
72.6%
79.7%
71.3%
UNIT 5
UNIT6
UNIT 7
UNIT 8

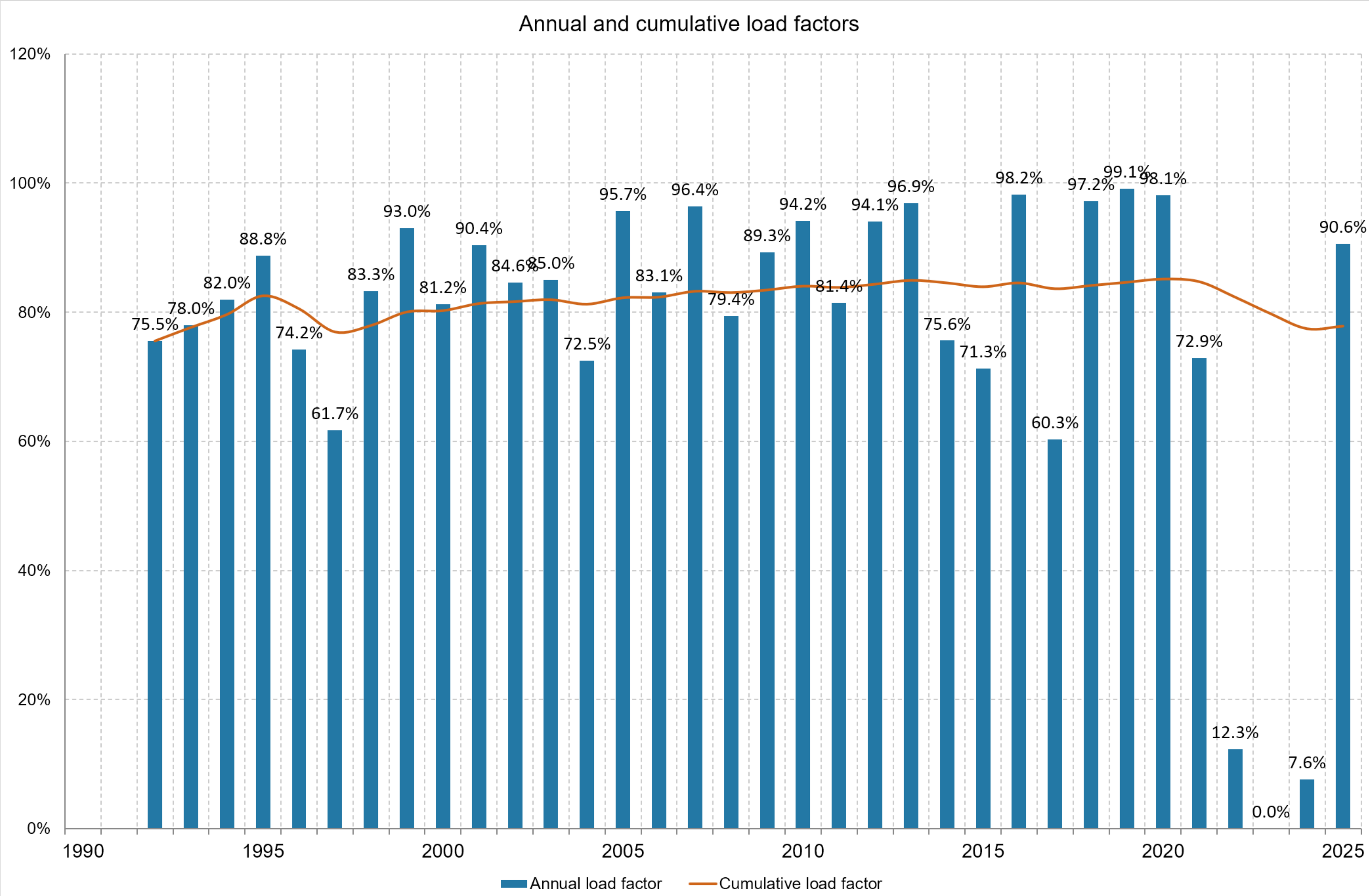
Darlington refurbishment and aftermath

Unit	Refurbishmen	Return to servi	Duration (days)	TIME LINE
Unit 1	2022-02-15	2024-11-27	1016	February 2022–November 2024
Unit 2	2016-10-14	2020-06-04	1329	October 2016–June 2020
Unit 3	2020-09-03	2023-07-17	1047	September 2020–July 2023
Unit 4	2023-07-19	2026-03-12	967	July 2023–March 2026

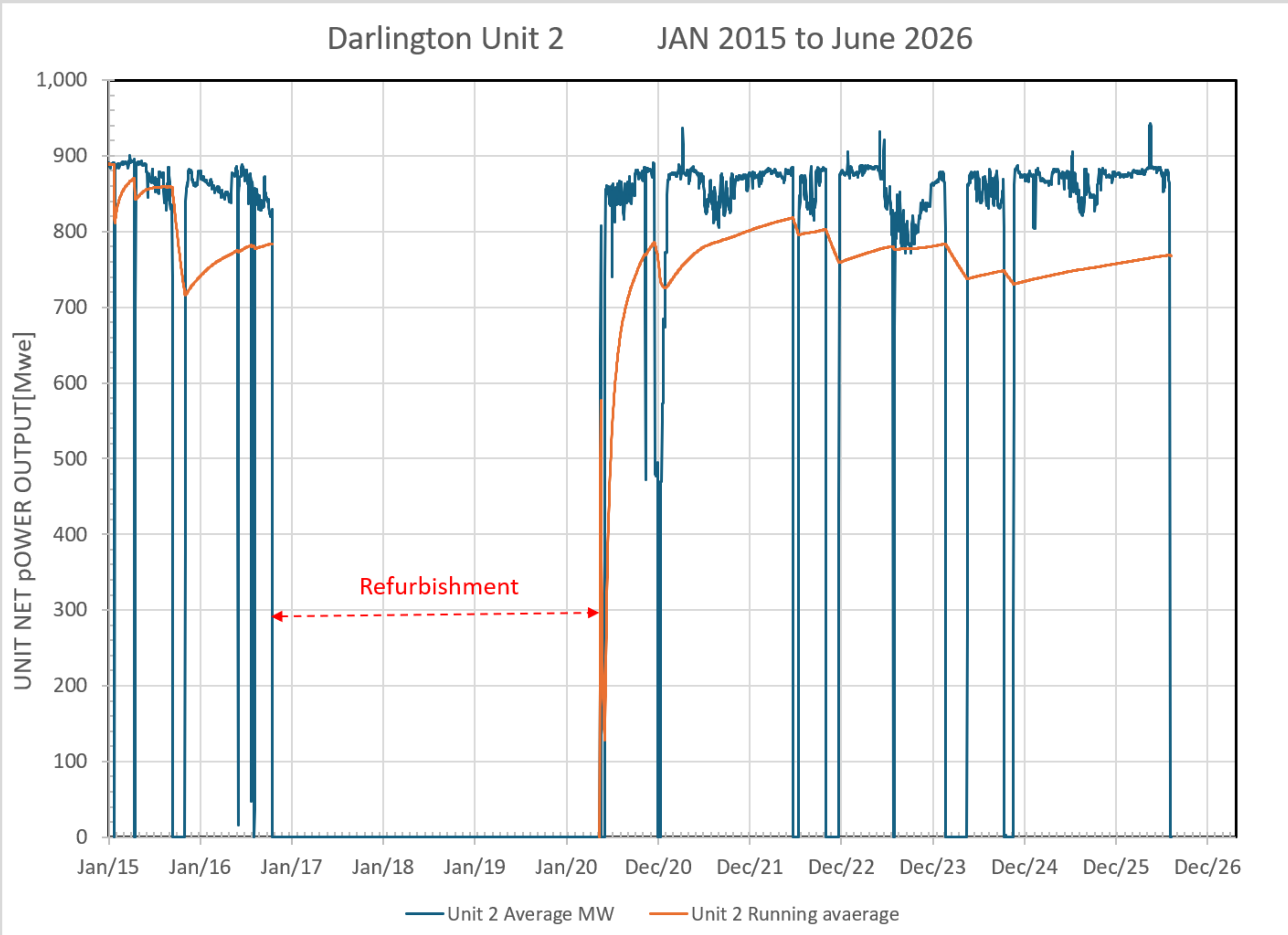
Darlington Unit 1 – 10 years



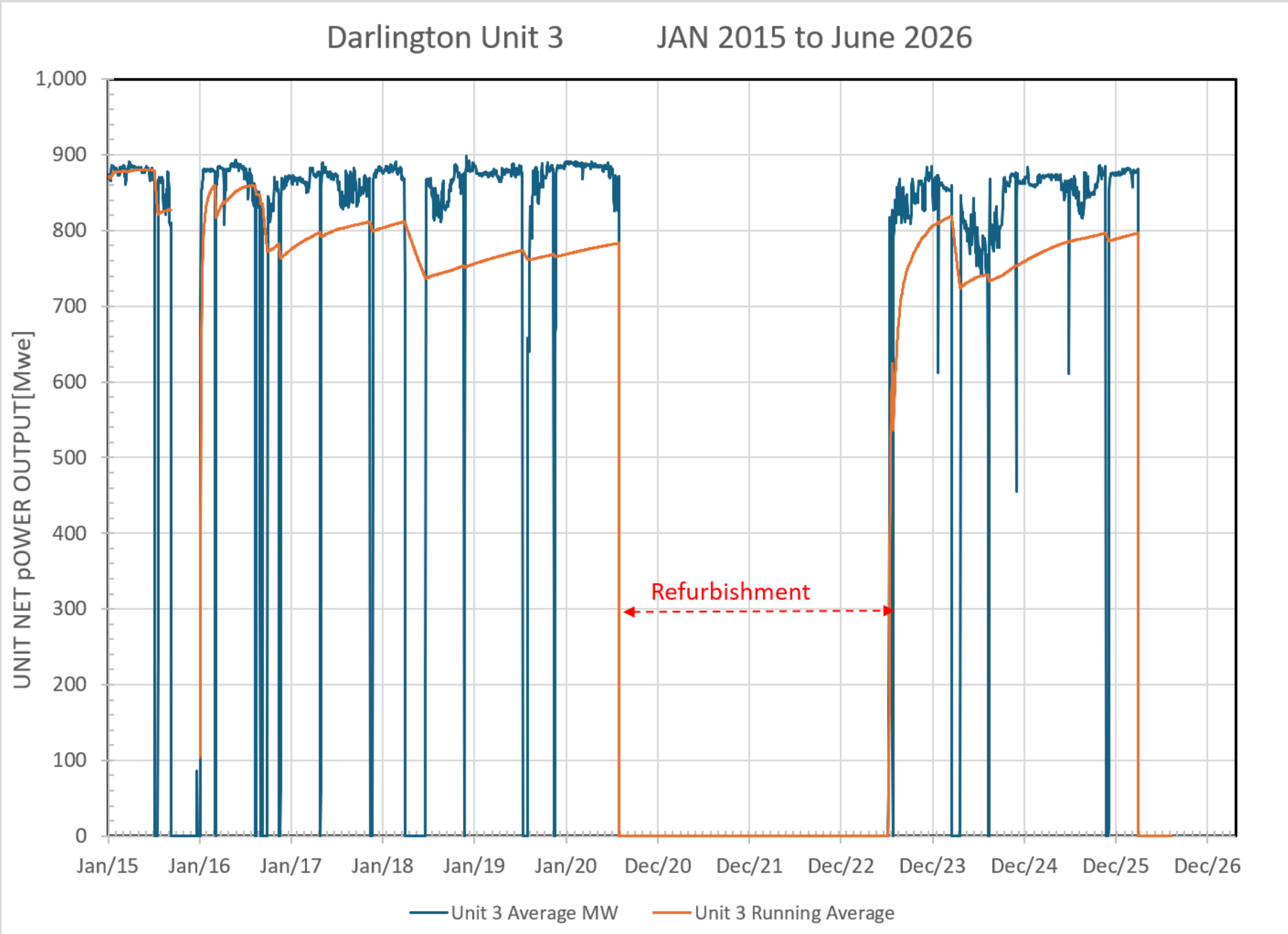
Darlington Unit 1 – 33 years



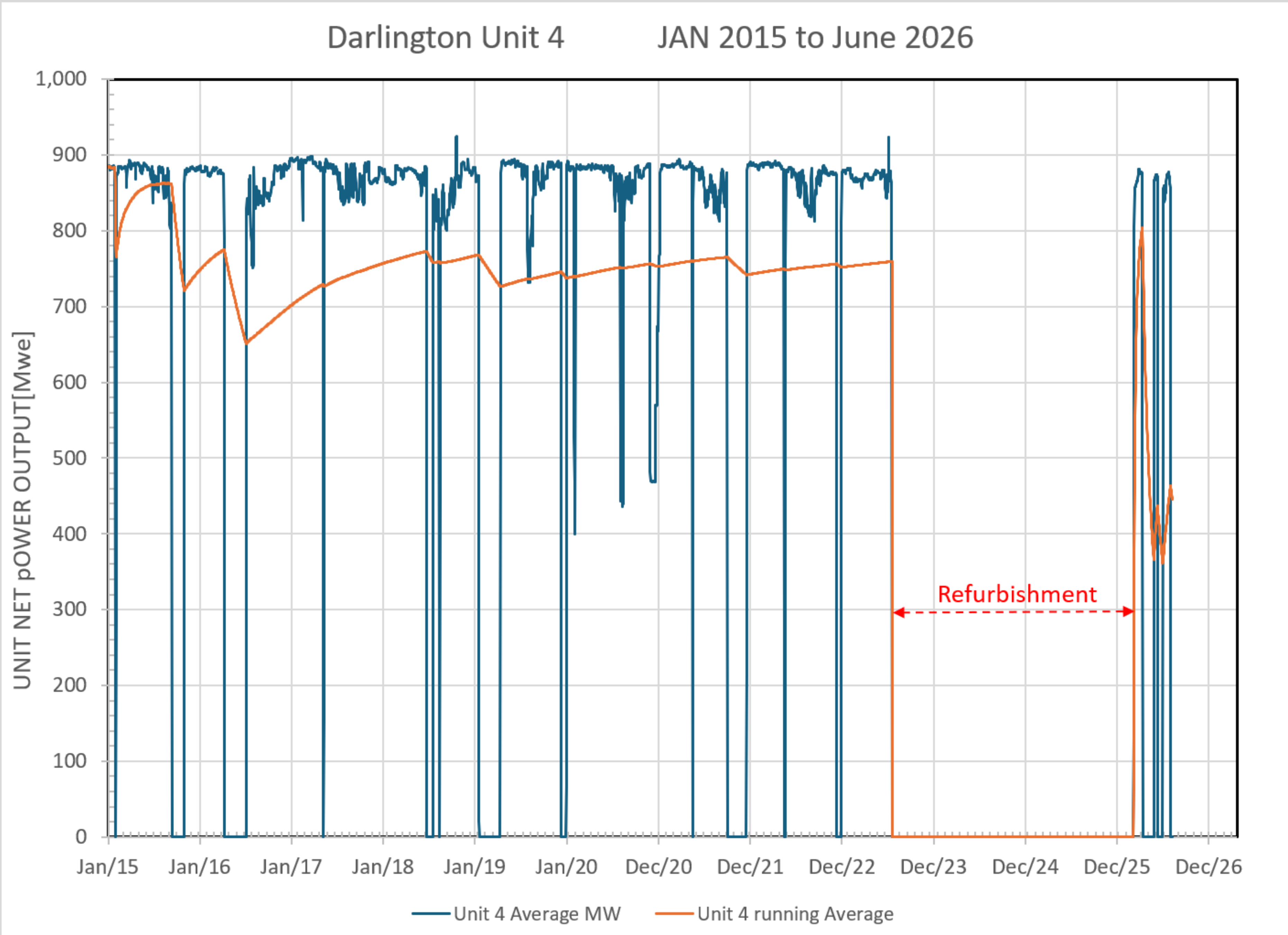
Darlington Unit 2



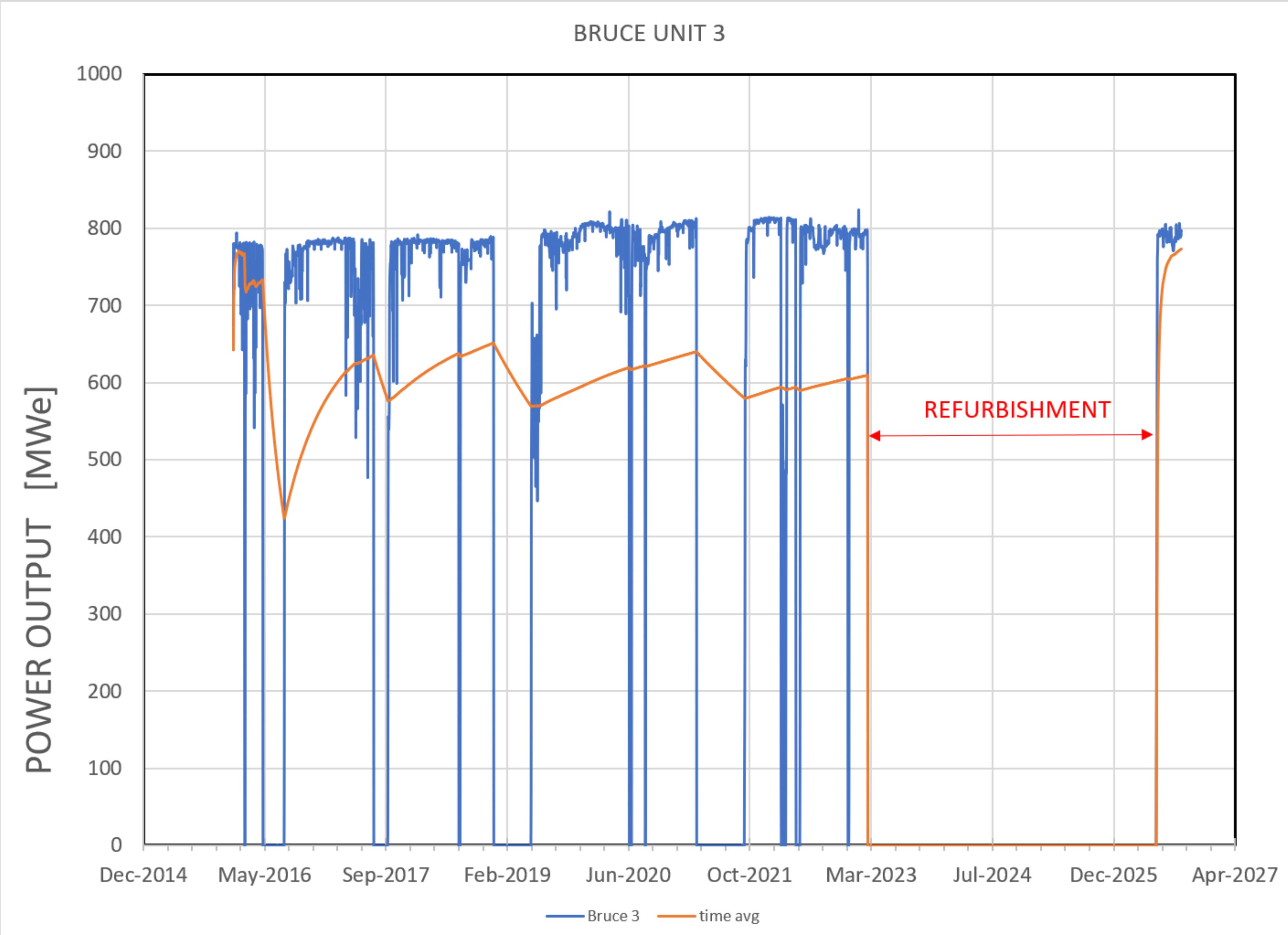
DARLINGTON UNIT 3



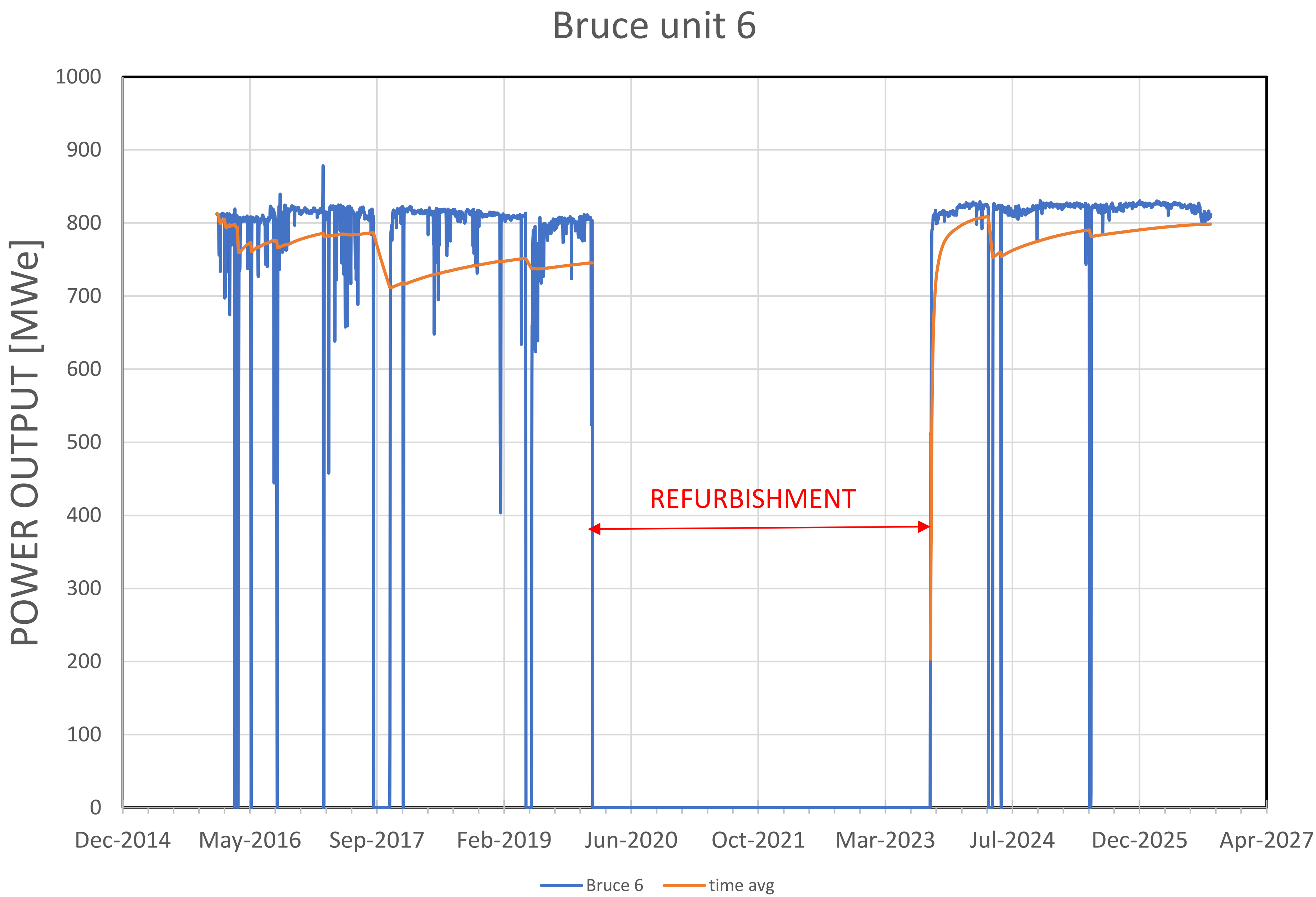
DARLINGTON UNIT 4



BRUCE UNIT 3


BRUCE UNIT 3
1000
900
800
700
600
500
400
300
200
100
0
POWER OUTPUT [MWe]
Dec-2014
May-2016
Sep-2017
Feb-2019
Jun-2020
Oct-2021
Mar-2023
Jul-2024
Dec-2025
Apr-2027
REFURBISHMENT
Bruce 3
time avg

Bruce Unit 6



Bruce unit 6
POWER OUTPUT [MWe]
1000
900
800
700
600
500
400
300
200
100
0
Dec-2014
May-2016
Sep-2017
Feb-2019
Jun-2020
Oct-2021
Mar-2023
Jul-2024
Dec-2025
Apr-2027
REFURBISHMENT
Bruce 6
time avg

COST ESTIMATES ARE EXAGERATED

Estimated cost by OPG for refurbishment = Cdn $26.7 Billion for 4 515 MW CANDU Reactors with nominal power of 4*515 = 2060 Mwe

For the advertised 2100 Mwe the cost

Unit cost = 26.7E9/(2100E03 Kw)= $12,714 / kw

Indian Rajasthan RAPP-3 **Cost of periodical refurbishment on account of En-Mass Coolant Channel Replacement (EMCCR) and En-Mass Feeder Replacement (EMFR)**

220 Mwe PHWR EMCCR & EMFR cost $ 49 million in 2024

₹2,977,200,000 × 0.01637 = C$48,736,764, or approximately C$222 per kW of the reactor’s 220 MWe capacity.

Wolsong-1: reported refurbishment expenditure ₩560–700 billion, approximately C$0.50–0.63 billion at 2011 exchange rates; published cost boundaries remain unreconciled.”
Unit Cost = 0.6E09 /600E03 = $1000/kW

NPCIL DOCUMENT EXTRACT FOR COSTS IN INDIA

Annexure -4 Completion cost of similar plants along with date of completion

STATION	Capacity (MW)	Completion Cost (₹ in Crore)	Commercial Operation Date
KAIGA-3	220	2715.04	06-May-07
KAIGA-4	220		20-Jan-11
RAPP-5	220	2361.81	04-Feb-10
RAPP-6	220		31-Mar-10

Cost of periodical refurbishment on account of En-Mass Coolant Channel Replacement (EMCCR) and En-Mass Feeder Replacement (EMFR)

STATION	Capacity (MW)	Completion Cost (₹ in Crore)	Commercial Operation Date after EMCCR
RAPP-3 : EMCCR & EMFR	220	297.72	24.07.2024

₹2,977,200,000 × 0.01637 = C$48,736,764, or approximately C$222 per kW of the reactor's 220 MWe capacity.

Indian refurbishment cost sources

Project	Reported cost	Date and meaning
Madras-1: 220 MWe PHWR life-extension/upgrading programme	**Approximately ₹220 crore**, or **₹2.2 billion**	Reported in January 2006 by NPCIL chairman and managing director S. K. Jain as expenditure on the unit's upgrading works.
Rajasthan-4 and Madras-2: replacement coolant-channel assemblies	**₹126.74 crore combined**, or **₹1.2674 billion**	MTAR's stock-exchange disclosure dated 26 August 2026. This covers supply orders for the two reactors, **not their total refurbishment costs**.

RECOMMENDATION

- **REJECT REFURBISHMENT PLANS – DESIGN IS TOO OLD AND EQUIPMENT IS LARGELY OBSOLETE.**

- Independent safety assessment to see if risk can be better quantified.

- Upgrade the reactors first to meet safety requirements and correct past design deficiencies.

- Competitive bidding on refurbishment.