Headquarters
New Zealand Defence Force
Defence House
Private Bag 39997
Wellington Mail Centre
Lower Hutt 5045
New Zealand

OIA-2023-4736

11th October 2023

[redacted]

Dear [redacted]

I refer to your email of 15 May 2023, to the Ministry of Defence seeking documents and correspondence relating to SSDF Tranche 14 or to information relating to the coal boilers at Burnham Military Camp. Your request was transferred to the New Zealand Defence Force (NZDF) in accordance with section 14 of the Official Information Act 1982 (OIA). I apologise for the significant delay in providing this response to you.

With respect to documents and correspondence concerning SSDF Tranche 14, a search of information from 1 January 2022 containing "decarbonisation", "coal", and "state sector decarbonisation fund" each returned more than 1,000 results. This part of your request is declined in accordance with section 18(f) of the OIA because of the substantial collation effort that would be required to remove false positives and prepare the information for release.

Information provided to senior leadership since 2020 concerning the coal boiler at Burnham Military Camp is enclosed. Where indicated information is withheld for the following reasons: specific capability is withheld in accordance with section 6(a) of the OIA; personal information is withheld in accordance with section 9(2)(a) of the OIA to protect privacy; the names of certain officials who provided advice are withheld in accordance with section 9(2)(g)(i) of the OIA to maintain the effective conduct of public affairs through the free and frank expression of opinion of public officials; signatures and contact details of NZDF personnel and staff are withheld in accordance with section 9(2)(k) of the OIA to avoid the malicious or inappropriate use of staff information, such as phishing, scams or unsolicited advertising.

You have the right, under section 28(3) of the OIA, to ask an Ombudsman to review this response to your request. Information about how to make a complaint is available at www.ombudsman.parliament.nz or freephone 0800 802 602.

Please note that responses to official information requests are proactively released where possible. This response to your request will be published shortly on the NZDF website, with your personal information removed.

Yours sincerely

AJ WOODS
Air Commodore
Chief of Staff HQNZDF

Enclosures:

1. Burnham Energy Centre Single Stage Light Business Case 2020 Draft
2. Ministerial letter, July 2020
3. Minute 106/2021 Request for Scope Change
4. Energy Centre Replacement Project Report, September 2022
5. Minute 275/2022 Burnham Energy Centre Replacement Project Co-funding

From: s. 9(2)(g)(i)
Sent: Thursday, 19 March 2020 11:33 a.m.
To: Sim Brian, Mr; s. 9(2)(g)(i)
Cc: s. 9(2)(g)(i) Stiven Reid, Mr
Subject: RE: For endorsement: BHM Energy Centre SSLBC
Attachments: FW: FOR REVIEW: [draft] Public Sector Decarbonisation Fund application BHM Energy Project [SEEMAIL] [COMMERCIAL-IN-CONFIDENCE]

Hi Brian,

Thanks for the chat to clarify the premise of the business case as a funding application.

Accordingly, we will not be including the below comment the business case as this will detract (and will confuse!) from the intention of the funding application to EECA specific to the BHM Energy project from the decarbonisation fund (as outlined below).

As discussed and attached; we have just now received feedback from EECA (who reviewed the draft business case) that decarbonisation funding will be recommended to the Minsters for 40% of the project cost (upon approval by the Ministers). This will result in a minor change to the business case around (a) seeking ACF from the DERP (10% for initial costs) and (b) acknowledgement of EECA they will be putting forward a "recommendation that this project (option 3) be co funded from the state sector decarbonisation fund at 40% of funding to maximum of $3,840,000".

Accordingly, DEI will access a portion funding from the DERP of this project (which has ATI $7.8M) but there will be a redundancy in the DERP related to this project that will be used to fund the electrical upgrade requirements, once the project are merged – when both projects have AIP.

We will be sending an email to the formalise the change to the business case to all endorsers very shortly.

Thanks,

s. 9(2)(g)(i)
Planning Team Lead - DEI, Defence Estate and Infrastructure
New Zealand Defence Force | Te Ope Kātua o Aotearoa

P s.9(2)(k)

www.nzdf.mil.nz

A FORCE FOR NEW ZEALAND

From: Sim Brian, Mr
Sent: Thursday, 19 March 2020 9:26 a.m.
To: s. 9(2)(g)(i), s. 9(2)(k)
Cc: s. 9(2)(g)(i), s. 9(2)(k)
Subject: RE: For endorsement: BHM Energy Centre SSLBC

Hello s. 9(2)(g)

Endorsed by me noting s. 9(2)(g)(i)s recommended addition as below.

Cheers, Brian

Brian Sim
Director Financial Strategy and Modelling
NZDF Finance
Mob s.9(2)(k)
brian.sim@nzdf.mil.nz

From: s. 9(2)(g)(i)
Sent: Thursday, 19 March 2020 9:11 a.m.
To: Sim Brian, Mr s.9(2)(k)
Cc: s. 9(2)(g)(i), s. 9(2)(k)
Subject: FW: For endorsement: BHM Energy Centre SSLBC
Importance: High

Hi Brian,
I discussed this with s. 9(2)(g)(i) yesterday and requested the following be included in the case if possible.

"This $9.4m investment is part of the preferred option (option 3 as stated in the enclosed WSP report) which has a total cost of $20.9m. The difference of $11.5m is funded from the Defence Estate regeneration programme and has approval in principle."

I will ring to discuss. They need to get signoff ASAP because they need to submit the application tomorrow.

Cheers,
s. 9(2)(g)(i)

From: s. 9(2)(g)(i)
Sent: Wednesday, 18 March 2020 12:10 p.m.
To: s. 9(2)(g)(i), s. 9(2)(k)
Cc:
Subject: For endorsement: BHM Energy Centre SSLBC
Importance: High

Hi again s. 9(2)(g)(i)

Please find attached all documents needed for endorsement of this SSBC, as s. 9(2)(g)(i) noted he is on leave so unsure if he has been able to review and pass through to you s. 9(2)(g)(i).

Note: An updated sign off page has been sent through, so please use that one.
If there is any issues in reviewing and providing sign off please get in touch. Time is critical on this one.

Again the effort is appreciated,

Thanks,

s. 9(2)(g)(i)
DEI PMO Project Coordinator, Defence Estate and Infrastructure
New Zealand Defence Force | Te Ope Kātua o Aotearoa

M: s.9(2)(k)
www.nzdf.mil.nz

From: Gurnsey Phil, Mr
Sent: Tuesday, 17 March 2020 4:51 p.m.
To: s. 9(2)(g) [redacted], Mr; Butt Wally, Mr; MacLachlan John, Mr; s. 9(2)(g)(i) [redacted] Mr; Sim Brian, Mr; s. 9(2)(g)(i) [redacted]
Cc: s. 9(2)(g)(i) [redacted]
Subject: RE: For endorsement: BHM Energy Centre SSLBC

Endorsed. Well done!

Phil Gurnsey
General Manager Estate Strategy
Defence Estate and Infrastructure (DEI)
New Zealand Defence Force
Headquarters NZDF, Defence House, 34 Bowen Street, Wellington

M: +s.9(2)(k) [redacted]
www.nzdf.mil.nz

New Zealand DEFENCE FORCE

A FORCE FOR NEW ZEALAND

From: s. 9(2)(g)(i) [redacted]
Sent: Tuesday, 17 March 2020 2:46 p.m.
To: Butt Wally, Mr <s.9(2)(k) [redacted]>; Gurnsey Phil, Mr <s.9(2)(k) [redacted]>; MacLachlan John, Mr <s.9(2)(k) [redacted]>; s. 9(2)(g)(i), s. 9(2)(k) [redacted]; Sim Brian, Mr <s.9(2)(k) [redacted]>; s. 9(2)(g)(i), s. 9(2)(k) [redacted]
Cc: s. 9(2)(g)(i), s. 9(2)(k) [redacted]
Subject: For endorsement: BHM Energy Centre SSLBC
Importance: High

Good afternoon All,

Please find *attached* the DRAFT Single Stage Light Business Case (SSLBC) for the BHM Energy Centre project and *attached* enclosures for your **endorsement.**

Note: very quick turnaround required on this one, hence all endorsees receiving at one time. Please review asap and I will coordinate with each of you WRT getting a hardcopy around HQ for sign off.

s. 9(2)(g)(i) [redacted] **Please review and brief Brian so we can obtain his sign off first thing Thursday morning and advise if not achievable so we can work around.**

s. 9(2)(g)(i) [redacted] **If I can ask you to review asap so that sign off from HQ can be obtained.**

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EXECUTIVE SUMMARY

Introduction

1. The purpose of this Single Stage Light Business Case (SSLBC) is to:

   a. seek Approval in Principle (AIP) for capital investment of up to **$9.400M** for the Burnham Energy Centre project at Burnham Military Camp (BMC); and

   b. support a co-funding application to the State Sector Decarbonisation Fund for 40% of funding support to a maximum of $3.840M to contribute to the overall Approval to Commit Funds (ACF) for delivery of this project.

   c. ACF of $0.940M from the Defence Estate Regeneration Program (DERP) for design consultancy, engineering services, consenting (if required) and general project expenses to enable the design and tendering of this project.

2. This project has Approval to Initiate (ATI) for an indicative value of $7.800M within the DERP, at Ref D.

3. A co-funding application for 40% of the project cost, to maximum of $3.840M will, if approved, access the State Sector Decarbonisation Fund, administered by the Energy Efficiency and Conservation Authority (EECA).

4. If the funding application is approved, the remaining project cost will request ACF from the DERP, with 10% ACF being requested in this SSLBC.

5. This project is a Rough Order of Cost (ROC) of $9.400M, including 30% contingency. The estimated Whole of Life Cost (at Net Present Value) for the preferred option is **$23.836M** (35 yr).

6. Additional investment in electrical infrastructure of $10.500M is required outside the scope of this project to enable delivery of the preferred option. These requirements will be developed in a separate project but in parallel with the design for this project, and will be funded through the DERP.

7. Approval of this SSLBC will confirm AIP and support a funding application to the State Sector Decarbonisation fund. If approved, ACF will subsequently be sought to deliver a replacement energy solution at BMC. The preferred option for this project when delivered will:

   a. Provide a suitable thermal solution for all occupied buildings at Burnham Military Camp;

   b. Reduce CO_2 emissions by an estimated 93% - from 5.2 kt CO_{2e} to an estimated 0.34 kt CO_{2e};

   c. Reduced forecast operating expenditure from $1.360M to $0.797M; and

   d. Improve safety by reducing the need to operate in high risk environments.

Strategic Case

8. A user requirement requesting the provision of Energy Services to Burnham Camp was endorsed by key stakeholders and approved 26 Feb 15, Ref A.

9. This project was identified for inclusion in the IRP for FY15/16 and initially received ATI with indicative funding of $6.000M in Sep 15, though Ref B. The IRP is a legacy DERP, which focused on an investment in health, safety, security and compliance projects. The projects within the IRP were identified with indicative funding through the Defence Capital Plan based on the Defence Mid-Point Rebalancing Review 2013. The project was formally deferred in Jan 16 to support a capital funding rebalancing activity to the IRP, through Ref C.

10. Persistent under-investment in the Defence Estate has resulted in significant infrastructure deterioration. This culminated in a decision by the Government to begin a programme of work to produce a safe, modernised, fit-for-purpose Estate, which was confirmed by the Defence White Paper 2016, Ref E. The DERP Plan was first approved by Cabinet in Aug 16 which outlined programme planning out to 2030, Ref F. This project was reactivated within the DERP in Jul 16 with a revised ATI and indicative value of $ 7.800M, Ref D.

11. In Dec 16, WSP (formally Opus and WSP Opus) were engaged to assess and evaluate the most economic and sustainable fuel source solution for BMC, Ref L. Short listed options produced a recommended option for a semi-centralised biomass system with supplementary LPG, at a ROC of $38.5M. The project then stalled given the significant increase over anticipated cost.

12. The Ministry of Defence (MoD) issued an assessment titled 'The Climate Crisis: Defence readiness and responsibilities' in Nov 18, Ref M. Key findings were that Defence should look into options for being more sustainable on camps and bases, and should work towards implementation of the Energy Policy, which promotes further exploration of opportunities around sustainability.

13. WSP were instructed to further assess energy supply types to support a stronger economic case, Ref M. Three concept designs were issued in May 19, with ROC's between $16.4M - $22.3M (± 30%). Since then, optimal strategic and economic approaches have been reconsidered for this project given the shortfall in the required funding from the DERP in order to pursue a low emissions solution for this project.

14. The MoD issued an implementation work plan titled 'Responding to the Climate Crisis: an Implementation Plan' in Nov 19, Ref N. The plan identifies the next steps for Defence in relation to climate change. This includes seeking low emission technologies for implementation across Defence, and the development of energy strategies for operational and non-operational non-fossil-fuel energy use.

15. In early Jan 20 (budget sensitive briefing), the Treasury indicated to the NZDF that following Cabinet agreement to allocate capital expenditure to reduce State Sector greenhouse gases; a 'decarbonisation fund' was to be established with an ultimate objective for State Sector emissions reduction. Fund capital investments will occur under joint-Ministerial authority for Climate Change and Finance with administration by the Energy, Efficiency and Conservation Authority (EECA).

16. Investment principles and criteria are currently being defined to confirm applicable capital allocation from the fund; although there will be prioritised outcomes for "low emissions heating" solutions. As such, an application will now be made to access the Decarbonisation Fund for provision of capital funding to support the replacement of the BMC coal boilers with a low-emissions decentralised electric solution.

17. If this funding application is successful, this will ensure that sufficient funding is available to ensure the strategic and economic outcomes of both the Decarbonisation Fund and the DERP are delivered.

18. **At ATI approval:** Ref B, the definition of the project within the DERP was:

   a. "The existing Burnham heating boilers have been at the end of their economic life for some time and are a seismic risk. They now urgently need replacement. This provides an opportunity to replace the current steam boilers and at the same time consider the most efficient and economic method of providing energy to the Camp using the most sustainable fuel. This project will replace the boiler house with an Energy Centre".

19. **Current State:** The existing energy system at Burnham Military Camp consists of two central coal fired boilers and a 6 km network of reticulated steam pipework located in underground service tunnels and ducts.

20. The boiler system is used year round in a varying capacity. The main boiler, a 3.6MW Babcock and Wilcox model, is a replacement installed in 1990 to provide space heating and domestic hot water (DHM) during the winter months. The secondary 2MW Vekos boiler dates back to original installation in 1968 and provides redundancy and surge demand in the winter, and is the main source of DHW during the summer months. The system was originally designed in a 2+1 configuration for redundancy but the two main boilers were replaced with a single larger unit, and the system now operates with little redundancy.

21. The existing boilers and steam reticulation network are approaching end-of-life and require replacement. Due to the length and poor condition of the steam reticulation network, current losses have been estimated to be approximately 430kW. Structural assessment of the boiler house and chimney has indicated that the complex is earthquake prone. Earthquake repairs and remedial strengthening has been carried out to improve safety, but the building remains vulnerable to future seismic events.

22. Overall the system is currently inefficient, lacks resilience, has limited redundancy and carries a significant carbon footprint.

23. **Problem statement:** The existing BMC energy system consists of aged equipment that is at, or near, the end of its economic life. It presents an increasing reliability and resilience risk, which may impact on the camps ability to deliver operational outputs. The current system:

a. is inefficient and produces high annual CO_2 emissions;

b. is made up of outdated equipment that is difficult to maintain;

c. is not flexible, the ability of the steam network to supply services to new buildings or equipment is severely constrained;

d. is not scalable, and cannot easily adjust to accommodate surge demand or fluctuating personnel numbers;

e. lacks resilience, particularly the steam reticulation system which is extremely fragile and has high energy losses; and

f. requires specialist personnel, the boiler plant must be manned 24/7 but there is a shortage of qualified operators.

24. **DERP Investment Objectives / Future State:** The future state will see the BMC Energy Centre project delivered to provide modern, functional, safe and efficient infrastructure. The DERP will invest in projects and programme work streams which deliver against the following investment objectives:

a. improve the ability to sustainably accommodate future military capabilities in an uncertain global environment;

b. improve the Defence Force's ability to meet demands to use and deploy military capabilities;

c. improve asset service level performance, operational efficiency and ease of use through optimised configuration;

d. improve the working, training and living environments for personnel and their families to promote the well-being, recruitment and retention of personnel;

e. continually meet legislative and government regulatory standards;

f. optimise asset investment decision making;

g. drive an increase in value over the life of investments; and

h. significantly reduce the carbon footprint of the NZDF Estate.

25. **State Sector Decarbonisation Investment Objectives:** The future state will see the BMC Energy Centre project deliver on the investment principles outlined in Ref O.

26. **Benefits:** The benefits of the BMC Energy Centre Project are (Encl. 1):

    a. Improved regulatory compliance and reduced emissions;

    b. Maintaining habitable working, training and living environments;

    c. Improved efficiency & effectiveness of energy provision to the Base; and

    d. Protecting BMC's ability to operate (resilience, surge capability).

27. **Project Scope**

Investment Objectives	
The project is limited to:	a. Upgrade heating systems in buildings currently serviced by the centralised heating plant, with electrical powered VRF or Split Hi-Wall solutions, as required, assessed on a building-by-building basis.
The project excludes:	a. Decommissioning of the existing underground pipe network and sub plantrooms unless required to deliver new services; b. Electrical infrastructure upgrades to provide the additional network capacity required to support an electrical heating solution. (noting, this project will be designed and delivered in parallel as a separate project)
Desired scope options:	a. The decommissioning of all above ground plant and capping off of all internal pipework to reduce potential for water damage to the building fabric.
Optional scope items:	a. Substitution of air-to-air HVAC units with ground sourced or geothermal heat pumps to improve efficiency (where possible). b. Addition of supplementary solar water heating to reduce operating costs in locations where this is deemed economic. c. Addition of supplementary photovoltaic panels to provide onsite generation to improve resilience where this is deemed economic.
Strategic intent:	a. This project was initiated and planned with reference to the Burnham Estate Strategic Framework. As options were developed modular and distributed solutions were preferred as these give greater flexibility to allow changes in demand, which includes the consolidation and redeployment of services as outlined through the latest BMC Infrastructure Master Plan (IMP), approved Sep 19. Future designs will be developed with further consideration to the latest IMP, while adhering to the scope limitations of this project.
Constraints and dependencies:	a. Additional investment in electrical infrastructure outside the scope of this project is required to enable delivery of the preferred option. These requirements will be developed in a separate project in parallel with the design for this project. b. That the project is undertaken with consideration of future plans to regenerate infrastructure at BMC, within the limitations of the scope of this project; c. That the design is compliant with the required standards.
Potential risks:	a. The custom Building Management System (BMS) built to operate the coal plant is obsolete and intermittently stops functioning. The BMS could fail entirely before the project is complete; Risk Ranking: Very High [Impact: Major; Likelihood: Likely] Risk Treatment: Replacement options are being investigated by the BMC DEI team, with the aim of installing a replacement by May 20. Risk is currently Untreated; treatment plan is in development. b. One (or both) of the coal boilers could fail prior to commissioning of the replacement system;

Investment Objectives	
	Risk Ranking: Medium [Impact: Major; Likelihood: Unlikely] Risk Treatment: The boilers are subject to ongoing maintenance, however this cannot be guaranteed to prevent failure. Risk is currently Untreated. c. Part of the steam network could fail prior to commissioning, requiring the plant be shutdown, leaving the camp without heating for an extended time; Risk Ranking: Medium [Impact: Major; Likelihood: Unlikely] Risk Treatment: The plant was designed with a limited ability to sectionalize the network to allow repairs, however this ability is limited due to valve failure. Replacement valves will be held to replace failed valves as required. Risk is currently treated, revised Risk Ranking is Low [Impact: Minor Likelihood: Unlikely) d. A strong seismic event causes the boiler house or chimney to become unusable prior to commissioning; Risk Ranking: Medium [Impact: Major; Likelihood: Unlikely] Risk Treatment: Earthquake repair and structural strengthening is complete. This improves safety but the operational risk cannot be practically remediated. Risk is currently treated, revised Risk Ranking: Medium [Impact: Major; Likelihood: Unlikely] e. The required heating and electrical load has been estimated using the best information available, but cannot be guaranteed. Risk Ranking: Medium [Impact: Moderate; Likelihood: Possible] Risk Treatment: An allowance has been made in the proposed energy and heating capacity to provide tolerance for increased load. Detailed assessment of each building is required during design development. Risk is currently treated, revised Risk Ranking: Low [Impact: Major; Likelihood: Possible]

Economic Case

28. **Critical Success Factors**: the preferred option must:

   a. satisfy the stated investment objectives and user requirements;

   b. represent value for money;

   c. be affordable;

   d. be commercially viable;

   e. be achievable within allocated resources;

   f. be operationally viable;

   g. Improve the NZDF's ability to sustainably accommodate future capabilities;

   h. be scalable and flexible to support the future consolidation of BMC in line with the Infrastructure Master Plan; and

   i. provide a significant reduction in annual carbon emissions for the State Sector.

29. **Short-listed options**: the following short-listed options were selected from the long listed options and analysed to confirm the preferred option: The preferred option has been endorsed by all relevant internal and external stakeholders.

30. The identified options will increase demands on the electrical network and additional infrastructure investment of $8.4M - $10.5M will be required to provide further capacity to meet this demand. These requirements will be developed in a separate project in parallel with the design for this project, and will be funded through the DERP.

a. Option 0: **Do nothing.** Continue using the existing coal boiler plant as the primary thermal energy source. This is not considered a viable option as the boiler plant and steam network is at the end of its service life and carries an increase chance of critical failure, there is a shortage of trained operators and the plant has significant greenhouse gas emissions; The ROC is $0.000M, WOLC is $24.220M

b. Option 1: **Preferred Option**. Deliver a distributed heating solution using VRF or split system heat pumps. Install modular heat pump systems to provide heating and cooling in all buildings. This solution will be disruptive to implement in barracks blocks, but provides the largest reduction in emissions and presents an optimal balance of capital and WOLC costs. The ROC is $9.400M, estimated WOLC $23.836M.

c. Option 2: **Do less.** Deliver a distributed heating solution using VRF heat pumps with supplementary LPG. Install modular heat pump systems to provide heating and cooling, with distributed LPG boilers in areas of high heat load or surge demand. This concept was developed to balance between cost-effectiveness and sustainability. This is not the preferred solution as the storage and transport of fuel lacks resilience, national fuel reserves are limited and carbon offset costs are anticipated to increase. The ROC is $8.800M, estimated WOLC $26.505M.

d. Option 3: **Do more.** Develop a distributed thermal solution using VRF and Air to Water Source Heat Pumps (ASHP).This strategy is based on retaining the existing systems in buildings with a high heat load, and using ASHP systems to provide space heating and domestic hot water (DHW). Low heat load spaces would use VRF or split system heat pumps with direct electric DHW as in option 1. This is not the preferred option as the ASHP systems are inefficient when operating at the high water temperature required by the existing infrastructure. This results in a cumulative increase in both capital and operating costs. The ROC is $10.400M, estimated WOLC $30.598M.

31. The preferred option is Option 1, as it has the flexibility to adjust to changes in occupancy and user demand. It provides heating and cooling, allowing temperature control to improve thermal comfort and hence staff morale. It is modular and supports the future consolidation as outlined in the Infrastructure Master Plan. It will provide an estimated 93% reduction in Emissions, from 5.2 kt CO_{2e} to an estimated 0.44 kt CO_{2e}, at a cost of $2.25/Kg CO_2 saved.

32. Due diligence to support the preferred option (Option 1) is shown as Option 3 in the BMC Energy Centre Replacement Project Concept Design Summary Report, at Encl. 2. Note that the Capital cost shown in the concept report includes $10.5M for electrical upgrades to support this option, which are not captured in this SSLBC. These requirements will be developed in a separate project in parallel with the design for this project, and will be funded through the DERP.

Commercial Case

33. Upon attainment of Approval in Principle (AIP) from the HDEI, a funding application will be submitted to the State Sector Decarbonisation Fund. If approved, ACF will be sought to initially enable DEI to continue progression of the project through further design stages to completion of a Detailed Design. Each subsequent design stage will be submitted through the Design Gate Approval process for review and approval by Director of Estate Delivery. It is anticipated the design phases of the projected will be completed within 4 months

34. Following approval of the final Design Gate (Detailed Design) the project will be handed over to the BMC Estate Delivery Manager (EDM) who will assign an NZDF Project Manager (PM). Once the Project Management Plan (PMP) is confirmed, the NZDF PM will then progress the project through a suitable procurement pathway that will lead into the construction phase, through to Practical Completion and Project Closure. It is anticipated the construction phase of the projected will be completed in 12 months

35. Procurement for design and then construction will be undertaken in accordance with DFO 52, Vol 2. A suitable ACENZ contract is to be used for further consultancy engagements, with a suitable NZS construction contract for the main contractor. All contracts will include NZDF Special Conditions, adapted as applicable. The PM will lead the project as the NZDF representative "Principle" in project decision making. DEI business partners for Defence Commercial Services and/or Defence Legal Services are to be engaged as relevant.

Financial Case

36. Capital investment of up to $9.400M (including 30% contingency) is required for the preferred option. The expected capital spend for FY19/20 is $0.940M with $8.46M for FY20/21. The capital investment requested is a ROC and includes a cost variance of approximately 40%.

37. Upon approval of this SSLBC by HDEI, a co-funding application will be submitted to EECA to request access for funding from the State Sector Decarbonisation Fund. The application process will be managed by the DEI Sustainability Manager with support from Finance Branch.

38. This application will request 40% of the project cost, to maximum of $3.840M. Funding for the remaining project costs will be sought from the DERP.

39. The annual operating cost is estimated at $0.797M which can be managed in current operational baseline. Current operational expenditure is estimated at $1.360M.

40. The estimated Whole of Life Cost (at Net Present Value) for the preferred option is $23.836M based on a 35-year appraisal period at a 6% discount rate (current Treasury default rate).

Management Case

41. **Project Governance:** will align with the responsibilities defined in the Project Management Team structure and Project Change Control Process (Annexes A, B). Significant change, issue or risk management will be assessed and responded to via the Project Review Board (PRB), as relevant.

42. **Project Management:** will align with the approved Capital Delivery Framework, with monthly project management reporting, including change, issue and / or risk management, reported through the Planview system for visibility to the PRB and other relevant NZDF stakeholders.

43. Upon attainment of AIP a funding application will be submitted to the State Sector Decarbonisation Fund, if approved ACF will be sought to initially enable DEI to continue progression of the project through further design stages, from preliminary and/or developed through to detailed design, including any consenting (if required). This will occur in consultation with relevant stakeholders with formalised Design Gate Approvals from the Director of Estate Delivery.

44. Upon approval of the final Design Gate (Detailed Design) the project will be handed over to the NZDF PM. A Project Charter will be assigned and the PM will begin procurement steps (refer to Commercial Case) and prepare a PMP to manage the construction phase, through to Practical Completion and Project Closure. Estate Strategy, Estate Performance and Estate Asset and Environment teams are to be consulted with as directly applicable to this project.

45. It is estimated that the project will take a maximum of 18 months from AIP (at concept design) to practical completion, then remain open a further 12 months for completion of the defects liability period and project closure.

Next Steps

46. This Single Stage Light Business Case recommends that HDEI approve the BMC Energy Centre project as:

Approved s.9(2)(k) [redacted]

a. **AIP** of $9.400M;

Supported s.9(2)(k) [redacted]

b. **Support** for a co-funding application to the State Sector Decarbonisation Fund administered by EECA for 40% co-funding to a maximum of $3.840M;

Approved. s.9(2)(k) [redacted]

c. **ACF** Approval to Commit Funds (ACF) of $0.940M for design consultancy, engineering services, consenting (if required) and general project expenses to enable design development and tendering of this project;

Noted. s.9(2)(k) [redacted]

d. **Note,** the expected capital spend for FY19/20 is $0.940M with $8.46M for FY20/21; and

Noted s.9(2)(k) [redacted]

e. **Note,** additional investment in electrical infrastructure will be required to support the delivery of the preferred option. These requirements will be developed in a separate project in parallel with the design of this project.

Annexes:

A. Project Management Team

B. Project Change Control Process

C. Document References

Enclosures:

1. Project Benefits Realisation Plan
2. Burnham Military Camp Energy Centre Replacement Project Concept Design Summary Report by WSP, 14-Feb-20

ANNEX A

Project Management Team

The composition and responsibilities of the (minimum) Project Management Team is:

Role	Name	Description
Head of Estate and Infrastructure	Mr. Mark Brunton, Head of Defence Estate & Infrastructure	Holds the position of project sponsor.
Project Executive	Mr. Walter Butt, GM Estate Delivery, Defence Estate and Infrastructure	Responsible for the project achieving its objectives and forecast benefits. The Executive is also responsible for the Business Case and sub-delegated financial decisions throughout the project.
Senior User	Mr. John MacLauchlan, GM Estate Assets & Environment, Defence Estate and Infrastructure	Responsible for specifying the needs of the user, liaison with the project management team, reviewing designs when required, committing user resources, and undertaking a benefits realisation assessment following practical completion.
Senior Supplier	s. 9(2)(g)(i) [redacted], Estate Deliver Manager, Burnham (PRB member)	Responsible for representing the interests of those designing, developing, facilitating, procuring, implementing (and likely operating and maintaining) the project products; and committing or acquiring supplier resources. Accountable for the quality of products delivered and is responsible for the technical integrity of the project.
Project Planner	s. 9(2)(g)(i) [redacted]	Authorised to run the project on a day-to-day basis during project initiate, planning and design (development) phases of the Capital Delivery Framework. Responsible for ensuring the project produces the required products within these phases to the specified tolerances of time, cost, quality, scope, risk and benefits. Also responsible for the project producing a result capable of achieving the investment objectives and benefits defined in the business case.
Project Manager	s. 9(2)(g)(i) [redacted]	Authorised to run the project on a day-to-day basis from project execute through to project closure phases of the Capital Delivery Framework. Responsible for ensuring the project produces the required products within these phases to the specified tolerances of time, cost, quality, scope, risk and benefits. Also responsible for the project producing a result capable of achieving the investment objectives and benefits defined in the business case.
Planning Team (Lead)	s. 9(2)(g)(i) [redacted]	Responsible for managing project level quality, risks and issues during project initiate, planning and design project management phases.
Programme Director (Estate Regen)	Mr. Reid Stiven (PRB member)	Responsible for managing programme level quality, risks and issues in the all project management phases of the project.

ANNEX B

Project Change Control Process

The tolerance levels for delegated authority of the Change Control (Management) Process are contained in the following table:

Area	Project Manager	Project Executive
Schedule	Changes to task milestones of up to 4 weeks, provided it does not alter the final milestone or incur additional costs. Impacts of changes to task and final milestones are reported via Planview to the Project Review Board (PRB) with risks or issues raised as required. Escalate other changes to the Project Executive.	Changes to task milestones of up to 12 weeks, provided it does not incur additional costs. Changes to the final milestone of up to 12 weeks, provided it does not incur additional costs. Impacts of changes to task and final milestones are reported to the Project Review Board (PRB) via Planview with risks or issues raised as required. Escalate other changes to Head of Defence Estate and Infrastructure.
Budget	In accordance with the approved project cost at Approval In Principle (AIP) and Approval to Commit Funds (ACF). In accordance with the financial delegation confirmed in the Project Charter. Cost issues or risks are to be raised as required Planview. Escalate cost issues or risks to the Project Executive.	In accordance with the approved project cost at AIP and ACF. In accordance with the financial delegation confirmed in the Project Charter. Cost issues or risks are to be raised and reported as required to the PRB via Planview. Submit a Project Change Request as required. Escalate cost issues or risks through the PRB to the Head of Defence Estate and Infrastructure.
Quality	Good practice, compliance and standards: deliver the project in accordance with approved legislation, good practice guidelines and standards both referenced in the project Single Stage Business Case and accepted as industry quality standards. Make recommendations for changes in quality as required. Assurance: Manage project within an approved quality management plan.	Endorse or reject recommendations for changes in quality. Escalate to Head of Defence Estate and Infrastructure if necessary. Assurance – escalate quality issues and initiate a quality audit to manage and rectify substandard quality.
Scope	Manage project within the agreed scope confirmed in the SSLBC at AIP. Make recommendations for any required changes in scope beyond that approved at AIP. Scope issues or risks are reported via Planview with risks or issues raised as required.	Manage project within the agreed scope confirmed in the SSLBC at AIP. Endorse or reject recommendations for scope change. Scope issues or risks are reported via Planview with risks or issues raised as required. Submit a Project Change Request as required.

Area	Project Manager	Project Executive
Risks and Issues	In accordance with DFO 81, (refer to Annex D): continually assess, monitor and review risks, issues, dependencies and constraints. Either accept or mitigate low and medium risks and issues. Transfer high and critical risks and issues to identified risk owners. Continual risk and issue reporting via Planview. Advise Project Executive if measures for successful project delivery are likely to be compromised.	Monitor high and critical risks and issues. Provide treatment of risk and issues as required. Risk and issue reporting via Planview to the PRB. Advise Head of Defence Estate and Infrastructure if measures for successful project delivery will be compromised.
Benefits	Manage project within project's Benefits' Realisation Plan. Advise the Project Executive if defined benefits are likely to, or will, be compromised.	Advise Head of Defence Estate and Infrastructure if the project's benefits, as defined in the Benefits' Realisation Plan, will be compromised. Ensure the post-project review is complete to discover lessons learned. Recommend any variations to Head of Defence Estate and Infrastructure.

ANNEX C

DOCUMENT REFERENCES

	Document name	Date of issue	Version
A.	DPG User Requirement UR0246	26-Feb-15	
B.	Minute: 15/072: ATI Estate Regeneration Projects FY15/16	10-Sep-15	
C.	Minute: Request for Approval for Changes to the Infrastructure Regeneration Programme, approved 21 Jan 16	21-Jan-16	
D.	Minute: FY 16/17 Bulk Capital Budget Allocations: ATI Request	14-Jul-16	
E.	Defence Estate Regeneration Programme Plan 2016 - 2030	19 Aug 16	
F.	Defence White Paper 2016	2016	
G.	DFO 52 Vol 2 (Defence Force Orders for Procurement)	3 Nov 16	1.05
H.	DFO 32 Defence Facilities and Property Management	Nov 16	AL18
I.	DEMM (Defence Estate Management Manual)	01 Dec 14	NZDF/7600/15
J.	DFO 10 (Defence Force Orders for Safety)	11 May 2016	1.00
K.	DFO 81 (Defence Force Orders for Risk Management)	09 Jul 13	AL8
L.	BMC Energy Centre Replacement Project Concept Design Report (Opus)	25 May 17	Draft 1
M.	The Climate Crisis: Defence readiness and responsibilities	Nov 18	
N.	Responding to the Climate Crisis an Implementation Plan	Nov 19	
O.	T2019/4160 Treasury Report: Announcements for State Sector Decarbonisation Investment (In-Confidence)	17 Jan 20	v.1 (In-Confidence)

REPORTS, DOCUMENTS AND STANDARDS

	Document name	Date of issue	Version
✔	NZ Treasury - Better Business Cases: Guide to developing a Single Stage Business Case	30 Sep 15	
✔	NZ Treasury – Single Stage Light Business Case - template	Oct 18	Interim update
✔	Construction Industry Council Design Guidelines		
✔	Defence Estate & Infrastructure Health & Safety Manual	October 13	
✔	Estate Strategic Framework Burnham		
✔	Resource Management Act (1991)		
✔	Health and Safety at Work Act (2015)		
✔	Building Act (2004)		
✔	Managing Successful Projects with PRINCE2		2017 Edition
✔	Climate Change Response (Zero Carbon) Amendment Bill	13 Nov 19	

Project Number: 4-11555.01

Burnham Military Camp

Energy Centre Replacement Project
Concept Design Summary Report

14 February 2020

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Document Details

Date: 14 February 2020
Reference: 4-11555.01
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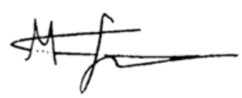
Prepared by



s.9(2)(a) [redacted]
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Senior Mechanical Engineer

Approved for release by

Jason Bretherton
Technical Director - Buildings

Document History and Status

Revision	Date	Author	Reviewed by	Approved by
Rev 1	27 January 2020	s.9(2)(a) [redacted]	[redacted]	Jason Bretherton
Rev 2	14 February 2020	[redacted]	[redacted]	Jason Bretherton

Revision Details

Revision	Details
Rev 1	Formal issue to NZDF
Rev 2	Formal issue to NZDF - Options 2 & 3 added

Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for The New Zealand Defence Force ('**Client**') in relation to proposed concept design for the upgrade of the heating system and electrical network upgrade across Burnham Military Camp ('**Purpose**') and in accordance with the short form agreement accepted by the client on 29th June 2018. The findings in this Report are based on and are subject to the assumptions specified in the report, short form agreement and original offer of service. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

In preparing the Report, WSP has relied upon data, surveys, analyses, designs, plans and other information ('**Client Data**') provided by or on behalf of the Client. Except as otherwise stated in the Report, WSP has not verified the accuracy or completeness of the Client Data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this Report are based in whole or part on the Client Data, those conclusions are contingent upon the accuracy and completeness of the Client Data. WSP will not be liable in relation to incorrect conclusions or findings in the Report should any Client Data be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WSP.

Contents

1 Executive Summary

The coal fired steam reticulation network at the Burnham Military Camp is near the end of its working life and needs to be replaced. In recent times, NZDF have made clear intentions to reduce their operational carbon footprint. The upgrade of the existing coal fired system is a key opportunity for the site to reduce its operational carbon emissions.

Four different options have been assessed for technical feasibility in this report and their predicted cost and carbon emission savings calculated. These options are:

- Variable Refrigerant Flow (VRF) heat pump systems in secondary / small scale buildings with direct electric hot water heating. Localised LPG boilers in primary / large scale buildings (retaining existing space heating & DHW plant).
- VRF heat pump systems in all buildings (primary and secondary) & direct electric water heating.
- VRF heat pump systems in secondary / small scale buildings with direct electric hot water heating. Air to Water Source Heat Pumps (ASHP) in primary / large scale buildings (retaining existing space heating & DHW plant).
- VRF heat pump systems in secondary / small scale buildings with direct electric hot water heating. Open Loop Ground Water Source Heat Pumps (GWSHP) in primary / large scale buildings (retaining existing space heating & DHW plant).

The results of the study are as follows:

Option	Estimated Capital Costs	Carbon emission saving vs existing coal fired system	Carbon emission saving per $ invested (capital)
	$	%	$/kg
Option 1 - VRF & LPG Heating Systems	20.4 million	76	5.44
Option 2 – VRF heat pumps & ASHP Systems	24.1 million	91	5.33
Option 3 – VRF heat pump systems in all spaces	20.9 million	93	4.53
Option 4 – Open loop ground source heat pump system & VRF heat pumps	Cost to be provided by QS	92	N/A

In summary option 3 (VRF systems in all spaces) provides the greatest carbon savings and the lowest estimated capital costs. It should be noted, that in terms of installation it could be considered more disruptive than the other three options as VRF indoor units would need to be installed in all rooms requiring heating.

Regarding options 2 and 4 (air and water source heat pumps), it was found that these systems cannot operate at optimum efficiency when connected to the existing radiators and hot water cylinders in the barracks buildings. This is because the flow and return temperature on the existing system (estimated at 80/70oC) is not conducive to efficient operation of these systems. As such, the predicted carbon savings are less than that of the traditional VRF system, even though more sophisticated technology is being used

2 Background

2.1 Context

The planet has warmed by around 1˚C since pre-industrial times, mainly due to human greenhouse gas emissions and this trend is accelerating. The world has agreed (as per the Paris agreement 2015) that we must limit warming to well below 2˚C, and that we should be aiming for below 1.5˚C. This requires global CO_2 emissions to reach net zero by early in the second half of the century, along with deep cuts in our polluting greenhouse gas emissions. Buildings in New Zealand currently account for around 20% of total carbon emissions, which highlights an urgent need for us to reduce emissions in this sector.

Changes in New Zealand Government policy are now driving an increased focus on the switching of fuel supplies from non-renewables to renewables (e.g. coal to electricity) to reduce the emissions for energy utilised across the state sector. The New Zealand Defence Force (NZDF) have responded with an implementation plan with regards to the climate crisis. This goes on to recognise how the impacts of climate change will become more pronounced as time goes on. It also examines the potential security implications of climate change and highlights the NZDF's position as a key stakeholder in the world's climate crisis.

Currently, NZDF have clear intentions to reduce their operational carbon emissions and WSP has been developing low emission design concepts for the replacement of the existing energy system at Burnham Military Camp (BHM). Presently, much of the space heating and DHW at the BHM is via an existing coal-fired steam boiler and subterranean pipe network distribution system. The remainder is achieved through retro-fitted electric heaters and heat pumps.

2.2 Previous work

WSP (formerly Opus and WSP Opus) have completed several reports to assess the existing infrastructure and undertake technical assessment and financial analysis for the options to replace the existing energy centre and meet the energy demands across the camp. Some of the buildings on-site have already been converted to use electrical heating solutions and others will be in the future.

2.3 Current installation

The existing coal-fired steam boilers and steam reticulation installed in service tunnels are approaching the end of their life and need to be replaced with a new heating system.

As reported in a previous energy audit of the BHM site, the total output of the existing steam boiler system is 5,600 kW, of which 2,000 kW is generated by Boiler 2 and approximately 3,600 kW generated by Boiler 3. Boiler 1 is no longer used for steam generation but is retained as a water storage tank.

During the winter season Boiler 3 operates to provide steam to the reticulation while Boiler 2 is kept hot for redundancy. In summer, Boiler 3 is kept turned off while Boiler 2 operate to provide heating for DHW (Domestic Hot Water).

The existing boilers generate steam at 9 bar. A pressure reducing station decreases the steam pressure from 9 bar (180˚C) to 2.6 bar (140˚C) before distributing steam to the site through the main reticulation pipework located in underground service tunnels and ducts that cross the site between the 36 sub-plantrooms. In general, each plant room has two steam to water heat exchangers (calorifiers) which are used for the following:

- Heating low temperature hot water (LTHW) for space heating via radiators, or convectors.
- Heating domestic hot water (DHW) storage tanks for general hot water use within buildings (temperature set-point 60˚C)

Due to the significant length and poor condition of the steam reticulation network, current losses have been estimated to be approximately 430 kW.

Although the total heating capacity may need more detailed assessments as the project moves forward, based on the above, together with the data provided by NZDF and previous assessments/reports, the peak of space heating capacity (excluding DHW production) to be delivered to the site has been estimated to be approximately 4,400 kW (considering the buildings ear-marked for demolition; B51, B52, B57, Y26, G32, Y37).

2.4 Focus of this report

As the steam reticulation network is approaching end of its life, this report identifies feasible alternatives for the heating requirements of the site. In previous reports, it was identified that the most capital cost-effective solution is to decommission the existing coal fired boiler system, retain the existing LTHW reticulations and install new high-efficiency, localised LPG boilers for each building. This would be in the same plantrooms as the existing steam-water and steam-DHW calorifiers. However, for aligning BHM with NZDF's carbon emission aspirations, several alternative options to using Liquefied Petroleum Gas (LPG) boilers are explored in this report. This is based on a feasibility assessment undertaken by WSP on 31 January 2020 and as-built drawing information provided by NZDF. The proposed solutions include:

- Variable Refrigerant Flow (VRF) heat pump systems in secondary / small scale buildings with direct electric hot water heating. Localised LPG boilers in primary / large scale buildings (retaining existing space heating & DHW plant).
- VRF heat pump systems in all buildings (primary and secondary) & direct electric water heating.
- VRF heat pump systems in secondary / small scale buildings with direct electric hot water heating. Air to Water Source Heat Pumps (ASHP) in primary / large scale buildings (retaining existing space heating & DHW plant).
- VRF heat pump systems in secondary / small scale buildings with direct electric hot water heating. Open Loop Ground Water Source Heat Pumps (GWSHP) in primary / large scale buildings (retaining existing space heating & DHW plant).

3 Concept Design Options

3.1 Overview

WSP has expanded upon their previous investigations and drawn from work undertaken by others to develop some proposed concept design options for the upgrade of the heating systems and associated electrical network upgrades across the Burnham Military camp. An overview of the new proposed heating strategies is described in this section. The currently proposed concept strategies are based on replacing the existing coal fired heating system with a predominantly electrical solution. This can be achieved in several configurations, as explained in this section. Buildings already using an electric heating strategy will remain as is. Appendix A is a sketch of the military camp site highlighting the future intentions for each building.

Buildings highlighted in blue are to be converted to VRF systems with direct electric water heating. These are mostly secondary / small scale buildings.

Building highlighted in green are mostly primary / large scale buildings and will be converted to either LPG, VRF, ASHP or an GWSHP system as explained below.

Buildings intended to remain with their current heating systems are highlighted in orange.

Buildings intended to be demolished are highlighted in black in the table of Appendix B. This strategy is as per the information provided by NZDF.

The tables in Appendix B, C & D are also coloured coded using the philosophy described above. This strategy is as per the information provided by NZDF.

3.2 Boiler House and Central Heat Generation Point

The existing coal fired heating system is to be fully decommissioned and the boiler house is to be demolished. This includes all coal storage hoppers, conveyor belts, and boiler flues. Heat will instead be generated locally to each building.

3.3 Option 1 - VRF & LPG Heating Systems

This strategy is based on primary / large scale buildings using LPG fired boiler systems coupled with a new plate heat exchanger (to provide hydraulic separation) to retain the existing space heating and domestic hot water (DHW) systems. Secondary / small scale buildings use VRF heat pumps with direct electric DHW systems.

Advantages

- Lowest electrical load requirement, so possibly reduces electrical infrastructure capacity upgrades required on-site
- Predicted lowest capital cost
- Minimizes disruption in the barracks by retaining the use of existing radiators and DHW systems

Disadvantages

- *Highest predicted carbon emissions of the four proposed solutions*
- *Still uses fossil fuels (LPG) which does not align with the NZDF climate crisis response plan*

LPG heating system configuration

Figure 1 shows the potential design configurations for the LPG fired boilers dependent on the required fuel storage for the system; bottles or storage vessels.

3.3.1 LPG storage vessels

(a) LPG storage vessels have the purpose of holding sufficient fuel to allow a supply autonomy for each heating system of about 7 days.
(b) LPG storage may be composed of multiple bottles (5a) when serving small sub-plantrooms.
(c) Where the LPG storage is connected to larger heating systems, a single vessel is preferred to multiple bottles. Sizes of LPG vessels/bottles are shown on the appended drawings

3.3.2 Sub-plantrooms new headers and connection to existing space heating system

(a) In each sub-plantroom the existing calorifiers (steam-water and steam-DHW) are to be demolished and new headers shall be built.
(b) Flow and return headers shall be connected via new plate heat exchangers with the existing system in a manner that allows to retain existing circulating pump(s) and control(s) for space heating secondary loop(s). New plate heat exchangers are necessary to protect the new boiler from corrosion and dirt which was accumulated in the existing LPHW reticulation over the years.
(c) A bypass between the flow and return headers is not required.

3.3.3 DHW calorifier replacement in sub-plantrooms to be converted to LPG systems

(a) Where a steam-DHW calorifier is installed in the sub-plantroom, it shall be removed and replaced with a LTHW calorifier having the same volume. The new DHW calorifier shall be equipped with twin coils to allow for future upgrade with solar thermal collectors.
(b) A new branch shall be installed on the flow and return headers to feed the upper coil of the DHW calorifier and achieve the DHW production using the LTHW system. This new branch shall be equipped with thermostatic control and with a new circulating pump for the LTHW loop.
(c) In C58, B52, B59, B01, A60, B62 and C65 DHW is principally produced by steam and electrical backed-up. In these buildings the new DHW calorifier shall be equipped with an electric heater.
(d) New calorifier shall be connected to the existing DHW system (including recirculating pump) (10).

3.3.4 LPG System control

(a) The system requires a BMS control panel located in each boiler house. The BMS shall be capable of controlling the boiler on/off based on site schedule. In addition, it shall be capable of monitoring the level of each LPG vessel in order to allow the site facility manager to schedule the fuel delivery.
(b) Each sub-plantroom shall be connected to the BMS (some existing sub-plantroom are not currently monitored by the BMS). Where DHW is produced via LTHW coil, BMS shall monitor the DHW temperature inside the calorifier and control the LTHW pump supplying hot water to the DHW calorifier coil.

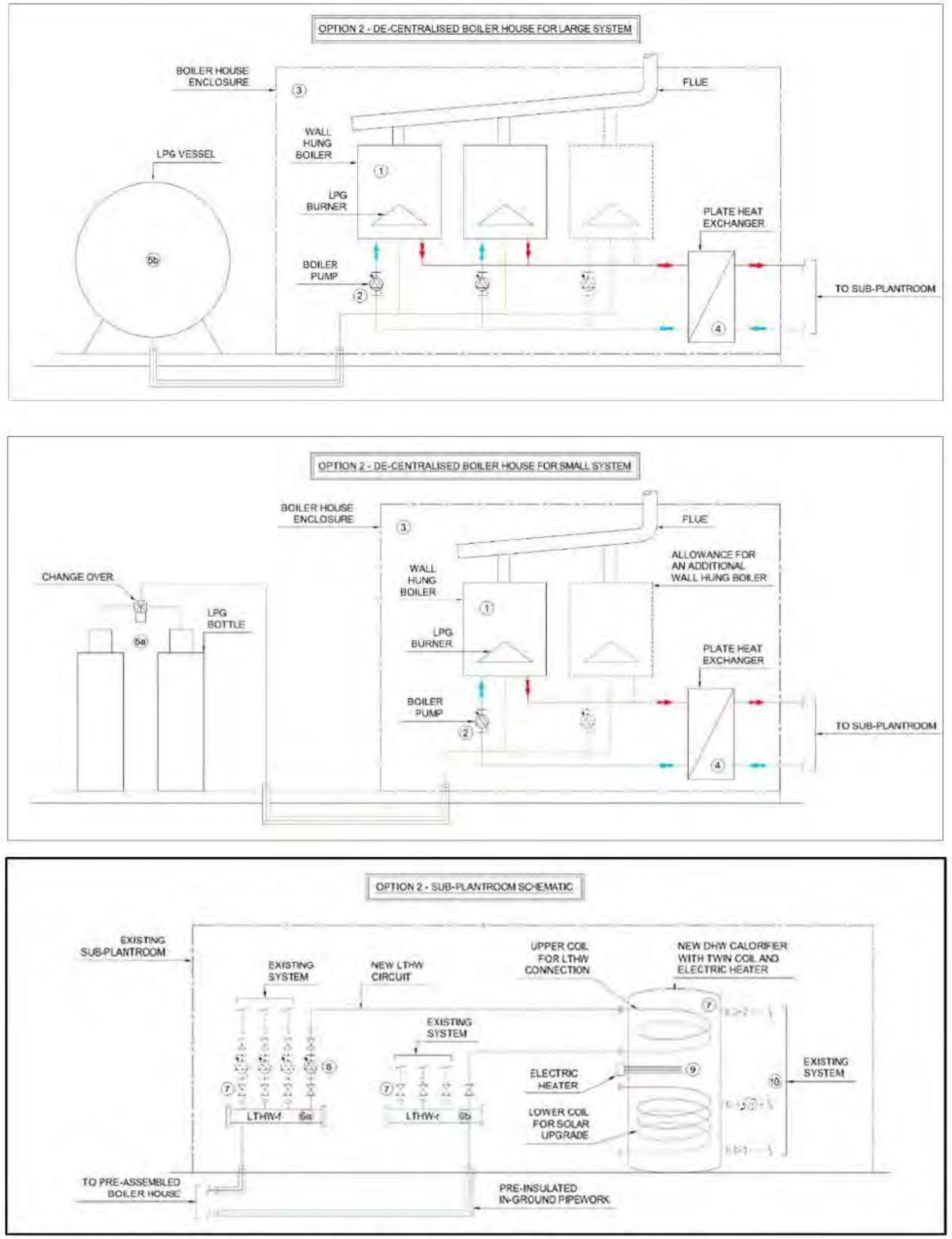


Figure 1 - Packaged plantroom configurations for large and small systems

VRF heat pump systems and direct electric water heating

Figure 2 shows the proposed configuration for VRF heat pump systems and direct electric water systems in each building.

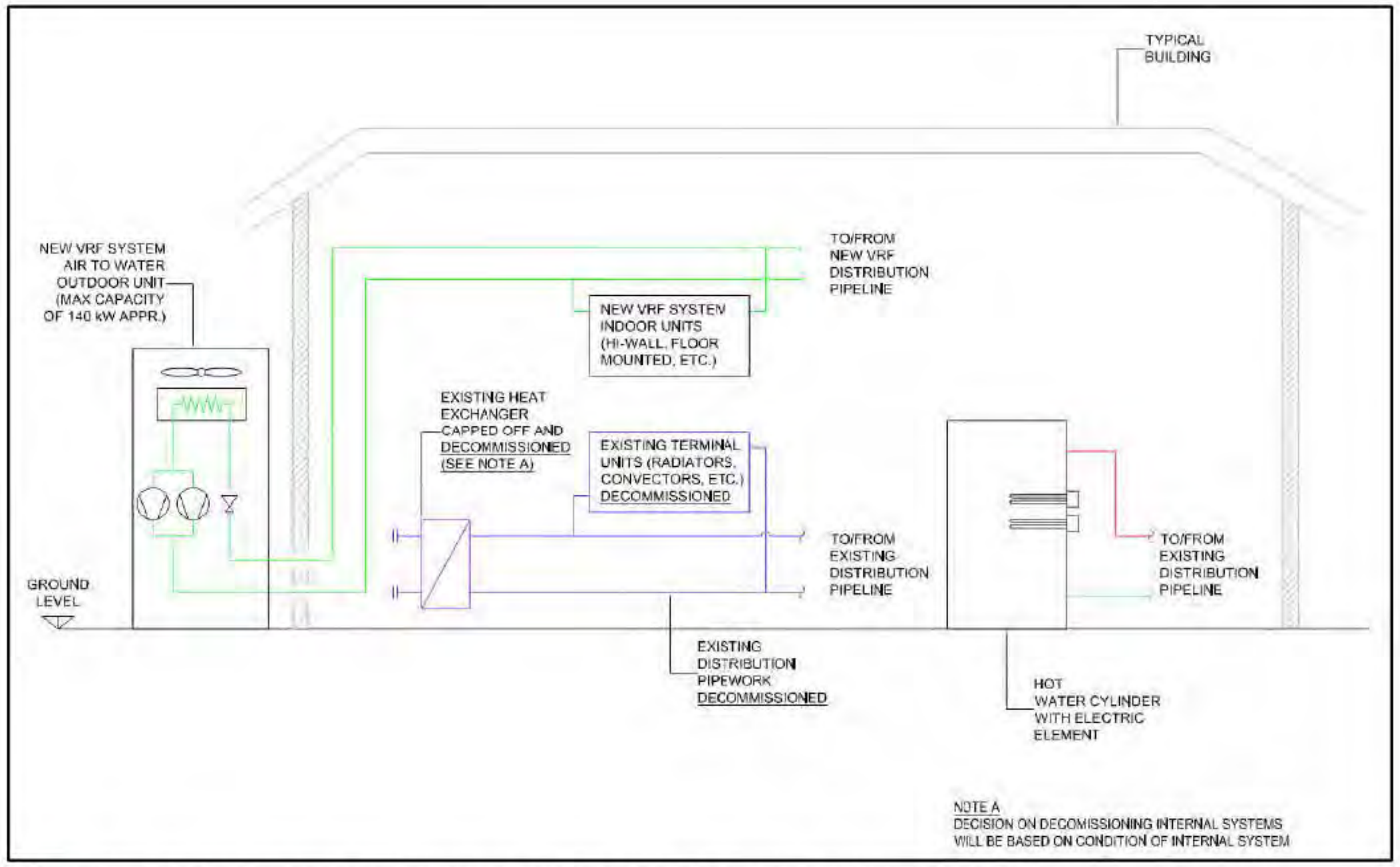


Figure 2 - VRF heat pump systems and direct electric water heating schematic

3.3.1 VRF systems

VRF systems or multi-room split systems shall be used in buildings where multiple indoor units are required. This is to reduce the number of outdoor units required on the external façade. This will be beneficial for noise, aesthetics and maintenance.

(a) 'Hi-wall' type units are the assumed default for installation. Floor standing units could also be used in bedroom areas to replace radiators if required.

3.3.2 Split systems

(a) In buildings where limited heating/cooling is required, single split systems may be used for cost saving purposes.
(b) Hi-wall' type units are the assumed default for installation

3.3.3 Wet system decommissioning

The existing wet heating systems and all 'above ground' heating plant is to be fully decommissioned, and appropriately capped off as part of the upgrade of this development. When existing plantrooms represent a H&S hazard (assessed by NZDF), they also will be fully decommissioned.

3.3.4 DHW calorifier replacement in sub-plantrooms to be converted to electrical systems

Where an existing DHW calorifer is installed in a building (steam or LTHW), it is to be replaced with a direct electric unit of equal specification and capacity.

3.3.5 Electrical systems control

(a) All VRF systems shall be controlled using wall mounted controllers provided by the manufacturer. They should be capable of time and temperature control.
(b) Where an existing BMS system is available, a fault/enable signal should be sent to the system so that the maintenance team can recognise faults remotely. VRF system may also be interfaced to the BMS to allow BHM to turn VRF systems on/off based on a central schedule

3.4 Option 2 – VRF heat pumps & ASHP Systems

This strategy is based on high heat load spaces using air to water source heat pump (ASHP) systems, a new plate heat exchanger (to provide hydraulic separation) and to retain the existing space heating and domestic hot water (DHW) systems. Low heat load spaces use VRF heat pumps with direct electric DHW systems.

Advantages

- Low carbon emissions
- Minimizes disruption in the barracks by retaining the use of existing radiators and DHW systems
- All electric solution aligns with the NZDF climate emergency response plan

Disadvantages:

- *Highest predicted capital cost of the three proposed solutions*
- *Requires large external plant area close to barracks*
- High electrical load requirement, so could require electrical infrastructure capacity upgrades
- *Using an ASHP with the existing radiator and DHW system (to produce LTHW at circa 75°C) causes the unit to not run at optimum efficiency. The manufacturers estimated co-efficient of performance (COP) to produce LTHW at these temperatures is around 1.8. Optimum efficiency would be closer to a COP of 3.5 (when generating water at 45/35°C). This reduces the carbon savings realised by the installation of this system.*

ASHP Heating system configuration

Figure 3 shows the potential design configurations for the ASHP heating system. This is based on a consistent plant area size for the selected 150 kW ASHP unit as shown on the plan in Appendix E.

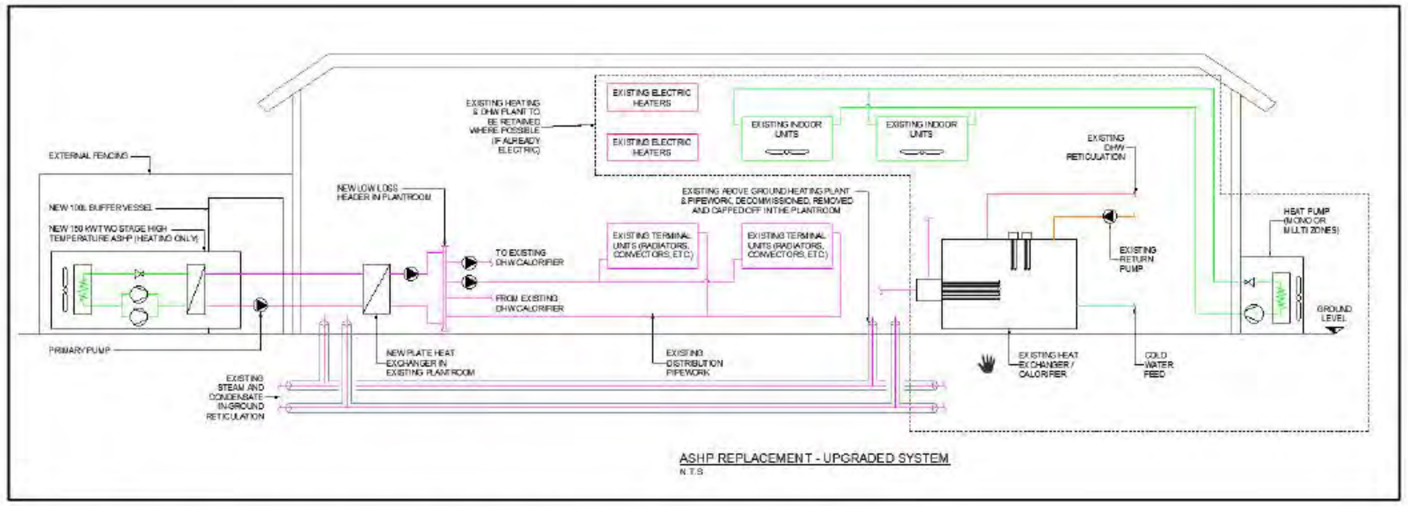


Figure 3 - ASHP Heating system schematic

3.4.1 ASHP systems

High temperature ASHP systems shall be used in high heat load buildings as indicated by rows highlighted in green in Appendix C. The LTHW (Low Temperature Hot Water) flow and return temperatures shall equal that of the existing installation (currently assumed to be 80°C/70°C). This is so the existing space heating radiators and DHW systems in each building can be retained.

150kW heating capacity units assumed as default size to be used at concept design stage

3.4.2 Plate heat exchanger

(a) In buildings where an ASHP is installed, a hydronic plate heat exchanger shall be used to provide a degree of 'separation' between the new and old systems.

(b) These units shall be manufactured using stainless steel type.

3.4.3 Buffer vessel

For a 150 kw ASHP used for heating, a 1000L buffer vessel shall also be installed. This is to prevent the unit from cycling on/off too frequently. The buffer vessel is nominally sized based on 6L/kW heating capacity.

3.4.4 External plant area

Approximately 50m^2 of external plant area will be required in each building using an ASHP. This is to accommodate; ASHP, buffer vessel and primary pumps. The plate heat exchanger and ancillaries will be in the existing plantroom.

The location of the proposed external plant areas and a rough is indicated in the drawings contained in Appendix E.

3.4.5 Electrical systems control

(a) All ASHP systems shall be controlled using a proprietary controller.

(b) Where an existing BMS system is available, a fault/enable signal should be sent to the system so that the maintenance team can recognise faults remotely. ASHP systems may also be interfaced to the BMS to allow BHM to turn ASHP systems on/off based on a central schedule

VRF Heat pump system configuration

The VRF system configuration for secondary / small scale buildings will be as per the description in option 1 above.

3.5 Option 3 – VRF heat pump systems in all spaces

This strategy is based on using VRF heat pumps with direct electric DHW systems in all spaces.

Advantages

- Low carbon emissions
- All electric solution aligns with the NZDF climate emergency response plan

Disadvantages:

- *Requires external plant area close to barracks for VRF outdoor units*
- High electrical load requirement, so could require electrical infrastructure capacity upgrades
- Causes disruption in the barracks for the installation of VRF hi-wall units and refrigerant pipework in rooms requiring heating

VRF Heat pump system configuration

The VRF system configuration for secondary / small scale buildings will be as per the description in option 1 above. It would also be possible to use floor standing VRF units in place of the existing radiators as per figure 4 in the next page.

Figure 4 – image of a floor standing VRF indoor unit and existing radiator system in the barracks

3.6 Option 4 – Open loop ground water source heat pump system & VRF heat pumps

Based on some high-level information provided by NZDF, the use of an open loop ground source heat pump system could be technically feasible for the BHM site. Historically there have been problems with the water levels coming from the boreholes, due to the high local requirements of water for irrigation in the Canterbury region. With the introduction of the Central Plains Irrigation Scheme Stage II, this is predicted to no longer be of concern in the future. This prediction could give the site access to a large volume of ground water that could be used for heat abstraction purposes.

Whilst it likely to be technically possible to use an open loop ground source heat pump system, some key considerations need to be made before this option is investigated further. These include:

- Drilling costs. From previous investigations, we know that drilling is difficult in the Burnham area which is likely to add additional cost to the proposal
- If the new open loop ground source heat pump is to be used with the existing heating systems in the barracks, it won't be able to run at optimum efficiency. This is explained further below. The capital cost for this system is likely to be quite high for a system that may not be used to its full potential.
- Depending on the agreed configuration of the system, it's possible that a new building could be required to house the GWSHP plant along with new buried pipework around the site.

See below a summary of the perceived advantages and disadvantages of this system.

Advantages

- Low carbon emissions
- All electric solution aligns with the NZDF climate emergency response plan
- Minimizes disruption in the barracks by retaining the use of existing radiators and DHW systems

Disadvantages

- *Requires large external plant area close to barracks*
- High electrical load requirement, so could require electrical infrastructure capacity upgrades
- *Using an Open Loop Ground Water Source Heat Pump with the existing radiator and DHW system (to produce LTHW at circa 75°C) causes the unit to not run at optimum efficiency. The manufacturers estimated co-efficient of performance (COP) to produce LTHW at these temperatures is around 2.5. Optimum efficiency would be closer to a COP of 4.5 (when generating water at 45/35°C). This reduces the carbon savings realised by the installation of this system.*

3.7 Associated Electrical; Upgrades

Much of the electrical infrastructure at BHM has been assessed to be in a moderate to poor state, largely due to lack of maintenance over many years. Earlier condition assessment reports by SKM in March 2013 identified the age and condition profile of the existing electrical high-voltage (HV) and low-voltage (LV) network cabling and equipment installed across the camp but excluding the electrical installation within individual buildings.

More recently in October 2017, DJY Design undertook a targeted review of the current state of the electrical infrastructure with an increased focus on resilience – to ensure that the safety and reliability of the electrical infrastructure such that the site's normal day to day operations could continue uninterrupted [10]. DJY also prepared a concept design and scope of work for the upgrade of the HV infrastructure and the replacement/upgrade of several LV substations and generator backup facilities across the site. In quantifying this work, strong consideration to flexibility and adaptability and the incorporation of a modular design such that the future installation would be aligned to the estate masterplan proposed for the BHM site

The scope of work identified by DJY has been subsequently costed by Rawlinsons in order to contribute to the overall capital cost for the Energy System Upgrades at BHM [11]. As such, many of the electrically based solutions require the reinforcement of and/or capacity increase in the electrical systems that deliver energy to the respective buildings.

4 Estimated Capital Investment

WSP have reviewed the Rough Order of Costs (ROC) estimate provided and aligned this information to the proposed heating strategy described in this document. Some buildings were not accounted for in the provided cost estimate and some of the NZDF predicted costs have been adjusted on a $/m² basis using the original Chas. E. George & Sons estimate as a basis. The NZDF cost estimates are highlighted in yellow in the table of Appendix B. These estimates have been revised.

4.1 Option 1 - VRF & LPG Heating Systems

The revised capital cost estimate for this proposal is circa $20.4 million.

The estimated cost breakdown for **option 1** is as per below:

Component	Cost
Electrical Upgrades	$8.4 million
Localised LPG Hot Water Upgrades	$4.1 million
Electric Heating Upgrades	$2.5 million
Design Fees	$2.2 million
Contingency	$2.2 million
Boiler House Demolition	$1.0 million
$/ kg CO_2 saved	**$5.44/kg**

4.2 Option 2 – VRF heat pumps & ASHP Systems

The revised capital cost estimate for this proposal is circa $24.1 million.
The estimated cost breakdown for **option 2** is as per below:

Component	Cost
Electrical Upgrades	$10.5 million
Localised ASHP Upgrades	$5.7 million
Electric Heating Upgrades	$2.5 million
Design Fees	$2.2 million
Contingency	$2.2 million
Boiler House Demolition	$1.0 million
$/ kg CO_2 saved	**$5.33/kg**

4.3 Option 3 – VRF heat pump systems in all spaces

The revised capital cost estimate for this proposal is circa $20.9 million.

The estimated cost breakdown for **option 3** is as per below:

Component	Cost
Electrical Upgrades	$10.5 million
Electric Heating Upgrades	$5 million
Design Fees	$2.2 million
Contingency	$2.2 million
Boiler House Demolition	$1.0 million
$/ kg CO_2 saved	$4.53/kg

4.4 Option 4 – Open loop ground source heat pump system & VRF heat pumps

It is estimated that this option would have the highest capital cost of the four options due to the requirement of additional borehole drilling. Whilst there may already be some extraction boreholes on-site that could be repurposed, discharge boreholes would also need to be provided. It is known that the ground in Burnham is difficult to drill through, so capita cost would likely be very high for this work.

Additional input from a Quantity Surveyor is required to estimate a figure for this option should NZDF wish to investigate further. Additional investigation beyond the scope of this study would also be necessary to develop a proposal. This option has been included in the carbon emission study below to demonstrate the potential carbon savings for this option should a study be developed.

5 Carbon Emissions

The tables below show the predicted carbon emissions for the site and the predicted carbon emission reduction for the proposed heating strategy. The updated coal consumption data provided by NZDF has been used as a basis for these calculations and emission figures have been derived from the Ministry of Environment (MfE) Emissions Guide. These figures can be found referenced in the table of Appendix B.

For buildings with a new proposed heat pump heating solution, it is assumed that 75% of the total thermal load is for space heating and 25% for DHW. The seasonal efficiency or coefficient of performance (SCOP) of the VRF heat pumps is assumed to be 3.6 (heating mode). The SCOP of the ASHP system is assumed to be 1.8 in heating mode. The SCOP of GWSHP system is assumed to be 2.5 in heating mode. The direct electric DHW cylinder is assumed to have an efficiency of 1. It is currently assumed that the cooling function of the heat pump units will be disabled for any buildings that do not currently have a cooling system. In case of LPG boilers, the seasonal efficiency is assumed to be approx. 90%.

Heating Strategy	Total Carbon Emissions ($kgCO_2$/annum)
Existing Coal Fired System	4,954,238
Concept design option 1 - VRF & LPG Heating Systems	1,209,453
Concept design option 2 - VRF heat pumps & ASHP Systems	437,274
Concept design option 3 - VRF heat pump systems in all spaces	339,959
Concept design option 4 - VRF heat pumps & GSHP Systems	374,689

Heating Strategy	Emissions reduction vs existing system (%)
Concept design option 1 - VRF & LPG Heating Systems	~76%
Concept design option 2 - VRF heat pumps & ASHP Systems	~91%
Concept design option 3 - VRF heat pump systems in all spaces	~93%
Concept design option 4 - VRF heat pumps & GSHP Systems	~92%

6 Complementary Upgrades

6.1 Kitchen Steam System

1. Where kitchen steam is provided by the existing steam reticulation, appliances shall be upgraded to localised electric units.
2. Where this isn't possible, steam shall be generated using an electric steam boiler situated in the mess plantroom.

6.2 BMS Upgrades

As mentioned in the previous sections, as part of the system upgrade, each sub-plantroom shall be connected to the site BMS to allow the site facility manager to monitor the working conditions and to set working schedules for minimise the primary energy consumption.

6.3 Thermostatic Heads and Valves on Radiators

To ensure a more precise temperature control and to achieve energy savings, where retained, existing radiators shall be equipped with thermostatic heads and valves where these are not already installed.

7 Sub-options

7.1 Buildings Requiring Redundancy (Island mode)

Buildings D04, A60, A62 B53, B62, C65, B59F,18, F,13, F06, Z04, X01, X02, X04, X05, X06, X33, X39 shall be equipped with VRF or multi-room systems to achieve functional continuity during island mode. Back-up electricity is supplied using on-site diesel generators and shall be managed via the BMS.

Works associated with the site generator upgrades have not been considered in this report. This work has been carried out by DJY who completed an electrical capacity assessment of the site. With the proposed concept design solution, the electrical load on-site is likely to increase. The electrical capacity of the generator should be cross-referenced with the new calculated electrical load and upgrades proposed if required.

8 Assumptions/Clarifications

1. All buildings currently using an electric heating strategy are to continue with this strategy and have no associated upgrade costs.
2. Energy usage analysis has been undertaken based on earlier energy demand and consumption figures assessed in the site energy audit undertaken by Enercon in 2014. Where applicable, these figures have been reconciled and adjusted to current energy consumption figures (coal and electricity) supplied by NZDF. It is assumed that provided coal consumption data accounts for all 'used' energy (difference between coal storage level at the beginning and at the end of the reference year has not been considered in this report).
3. The ROC cost estimate for the conversion/upgrade/replacement of existing heating systems serving the buildings across the camp includes:
   - Capital cost estimate
   - Design and consenting fees
   - Contingency
   - Escalation
   - Margins
4. WSP have used the data provided by Chas. E. George & Sons as a basis for estimating upgrade costs on a square metre basis. Capital cost information has been provided by mechanical equipment NZ supplier/distributor. This information was then used to revise the cost estimates supplied by NZDF. It is noted that ROC are purely indicative and shall be reviewed and confirmed by a Quantity Surveyor for final validation.
5. Heating loads, fuel consumptions and CO2 emission figures calculated and percentage of carbon reduction provided within this memo are indicative only at this stage and are subject to further refinement as the design develops and more information becomes available.

9 Additional Comments

9.1 BMS Upgrades

1. Detailed data of existing BMS facilities across the camp are not available. This aspect requires further investigations as the project moves forward.
2. Allowance for upgrading sub-plantrooms which are currently not connected to the BMS system shall be made.

9.2 Electrical System Upgrade

1. Some of the buildings listed in the appended tables require redundancy for the heating system. In these cases, an additional heat pump or VRF system shall be added as previously noted.
2. The addition of heat pumps / VRF system causes additional load on the electrical infrastructure which may need to be upgraded to accommodate additional load.
3. Allowance for upgrading the electrical system in such buildings shall be made where applicable.

10 References

The following documents have been referenced in compiling this report:

No	Document Name	Date	Author
[1]	NZDF Burnham Military Camp Energy Review – Economic Case	12 April 2016 (V8)	Opus
[2]	NZDF Burnham Military Camp - Energy Centre Replacement Project Concept Design Report	25 May 2017	Opus
[3]	NZDF Burnham Military Camp Energy Review - Economic Case	16 December 2017 (Ver6)	Opus
[4]	NZDF – Burnham Camp Assessment of Assets - Tunnels	30 November 2017	Opus
[5]	Burnham Military Camp – Heating Upgrade Options – Summary Report	30 January 2019 (Issue A)	WSP Opus
[6]	BHM Energy Centre Coal Data 18-20	22nd January 2020	NZDF
[7]	Level 2 Energy Audit	4th December 2014	Enercon
[8]	Measuring Emissions: A guide for organisations	May 2019	Ministry for the Environment
[9]	NZDF Burnham Military Camp – Heating Upgrade Options – Concept Options Estimates (Rev 3)	7 May 2019	Chas. E. George & Sons Ltd
[10]	Electrical Review	30 October 2017 (Final)	DJY Design Limited
[11]	Burnham Camp Electrical; Upgrade	15 July 2019	Rawlinsons Ltd
[12]	Burnham Camp Electricity Data	27th January 2020	NZDF

Appendix A

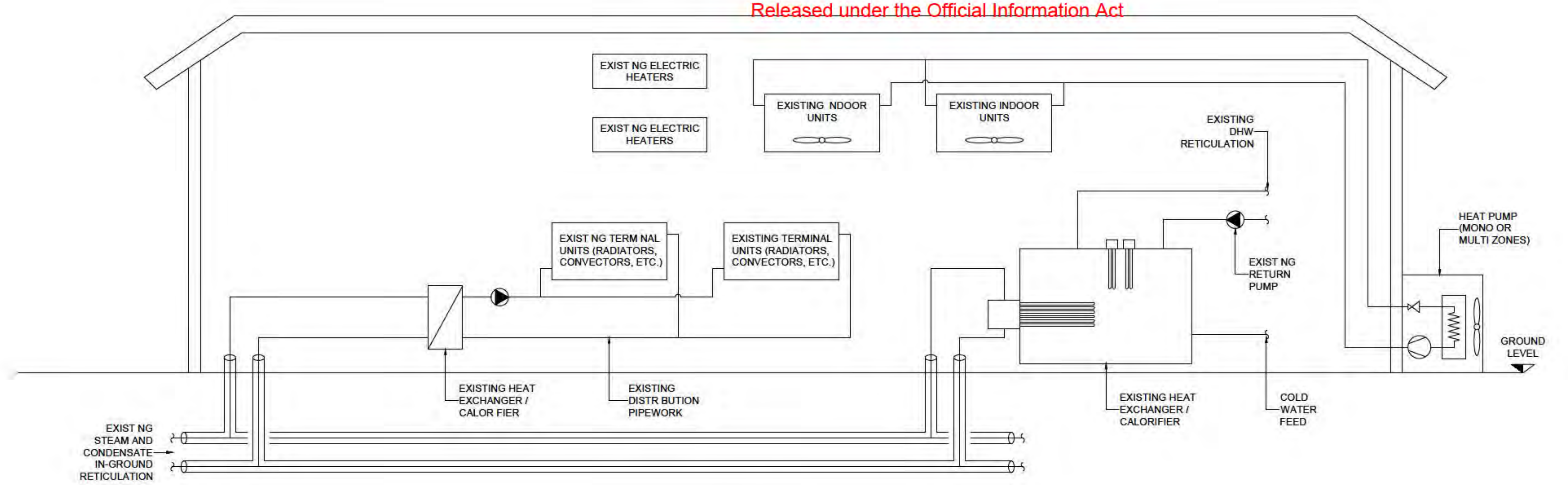
Proposed Site Layout

s.6(a)

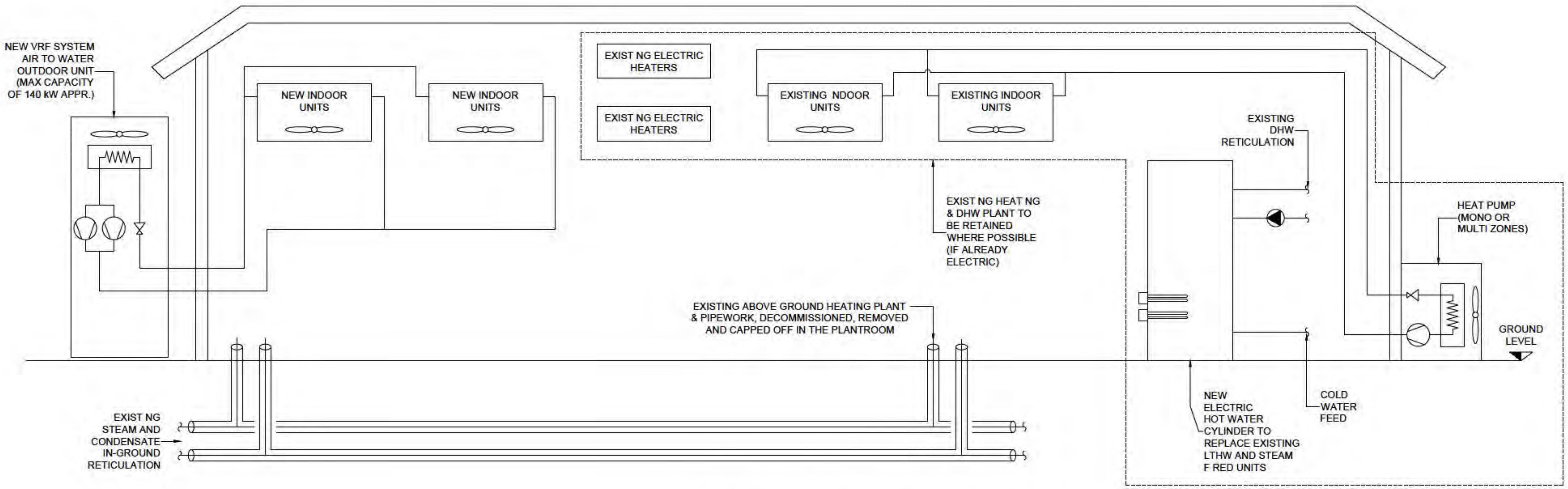
[redacted]

Appendix F

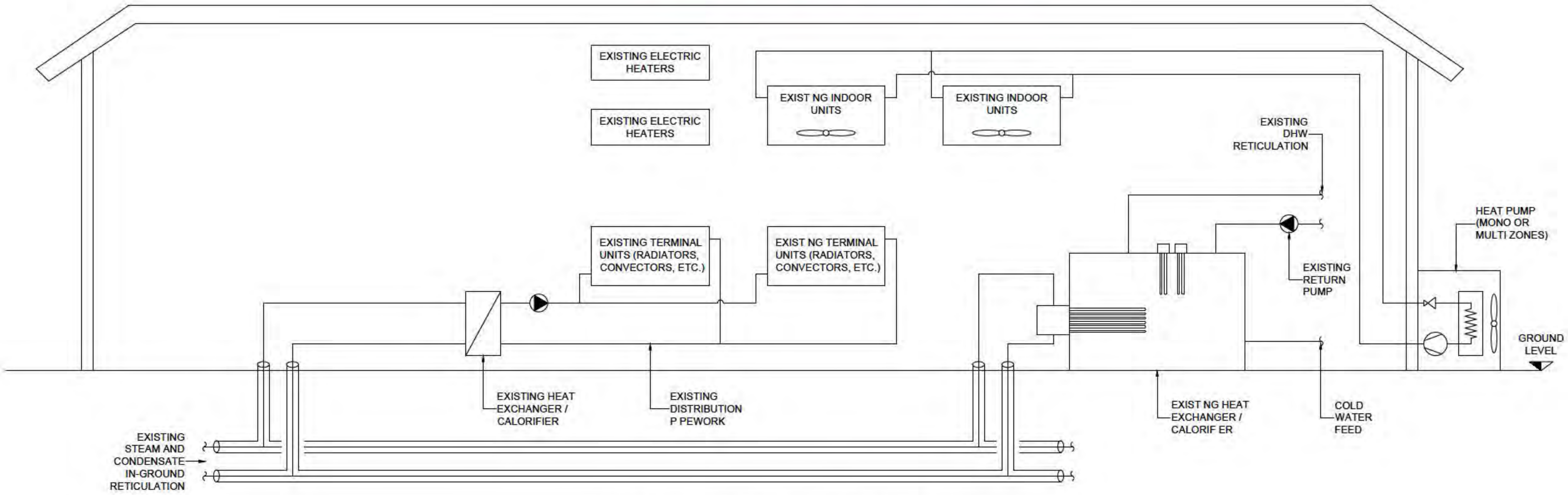
Proposed System Schematics



HEAT PUMP REPLACEMENT - EXISTING SYSTEM
N.T.S.

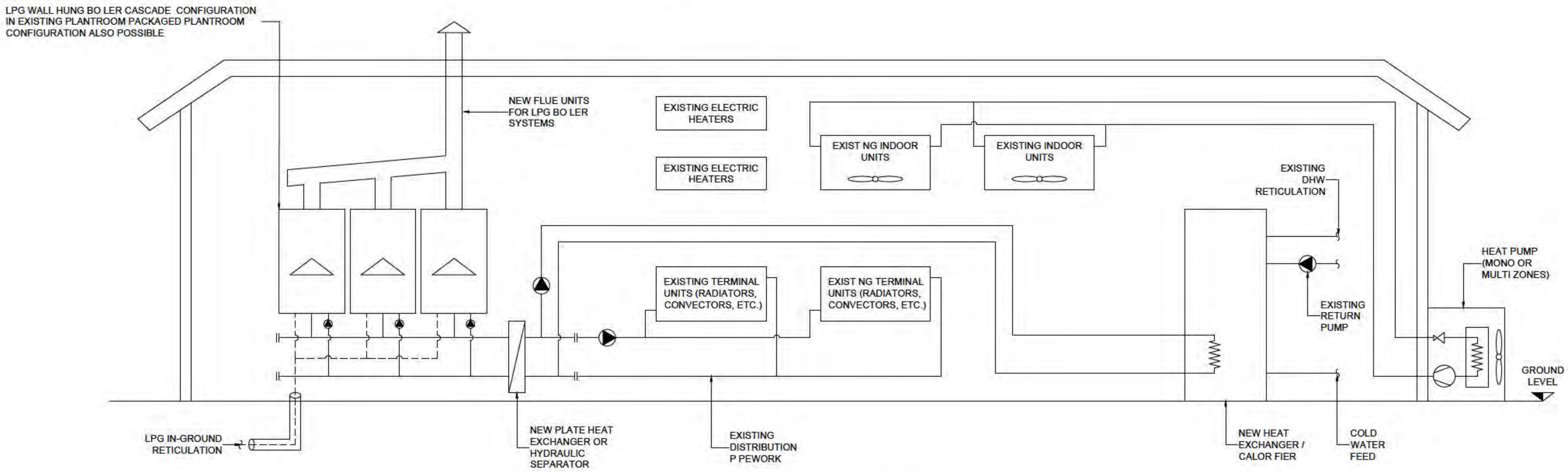


HEAT PUMP REPLACEMENT - PROPOSED SOLUTION
N.T.S.



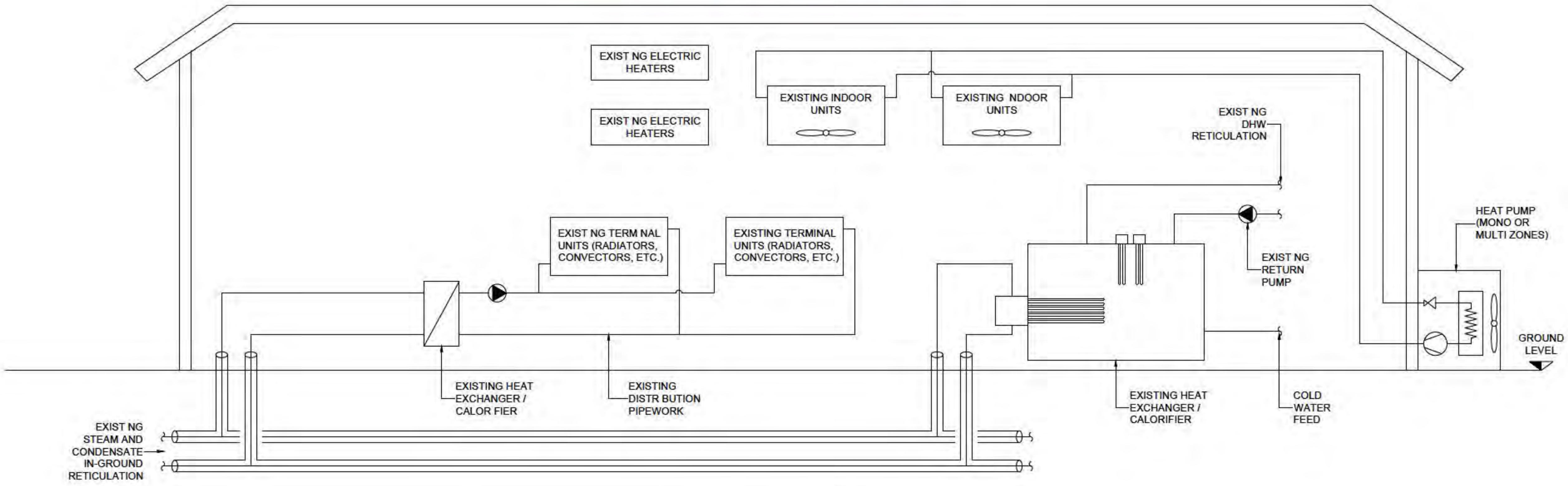
LPG BOILER REPLACEMENT - EXISTING SYSTEM

N.T.S.



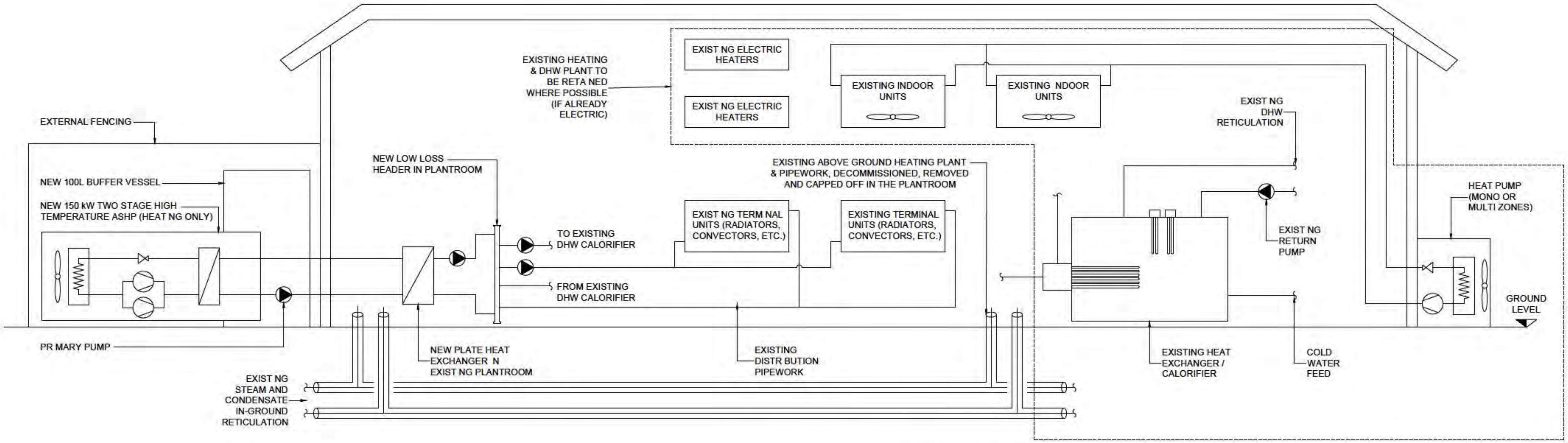
LPG BOILER REPLACEMENT - PROPOSED SOLUTION

N.T.S.



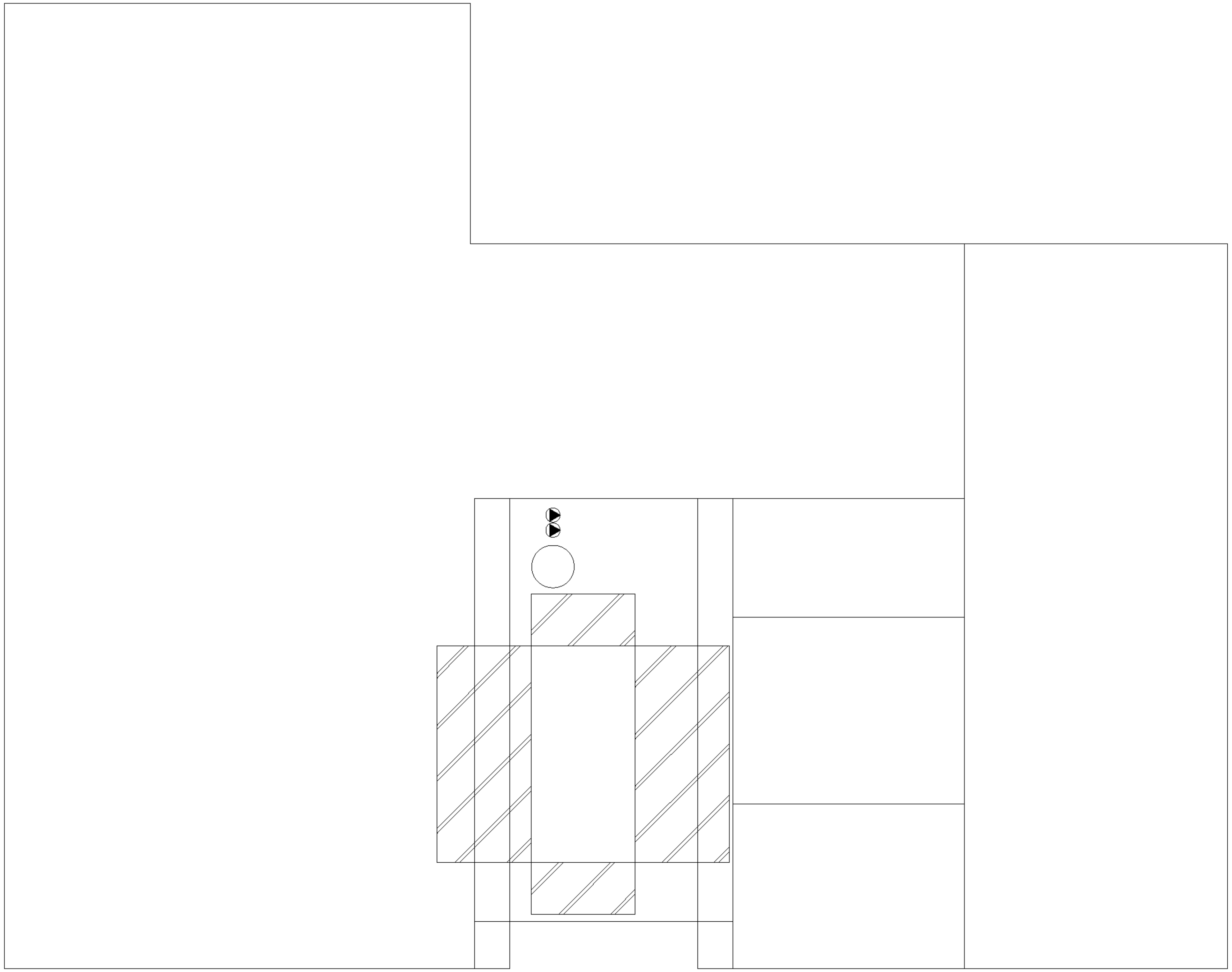
ASHP REPLACEMENT - EXISTING SYSTEM

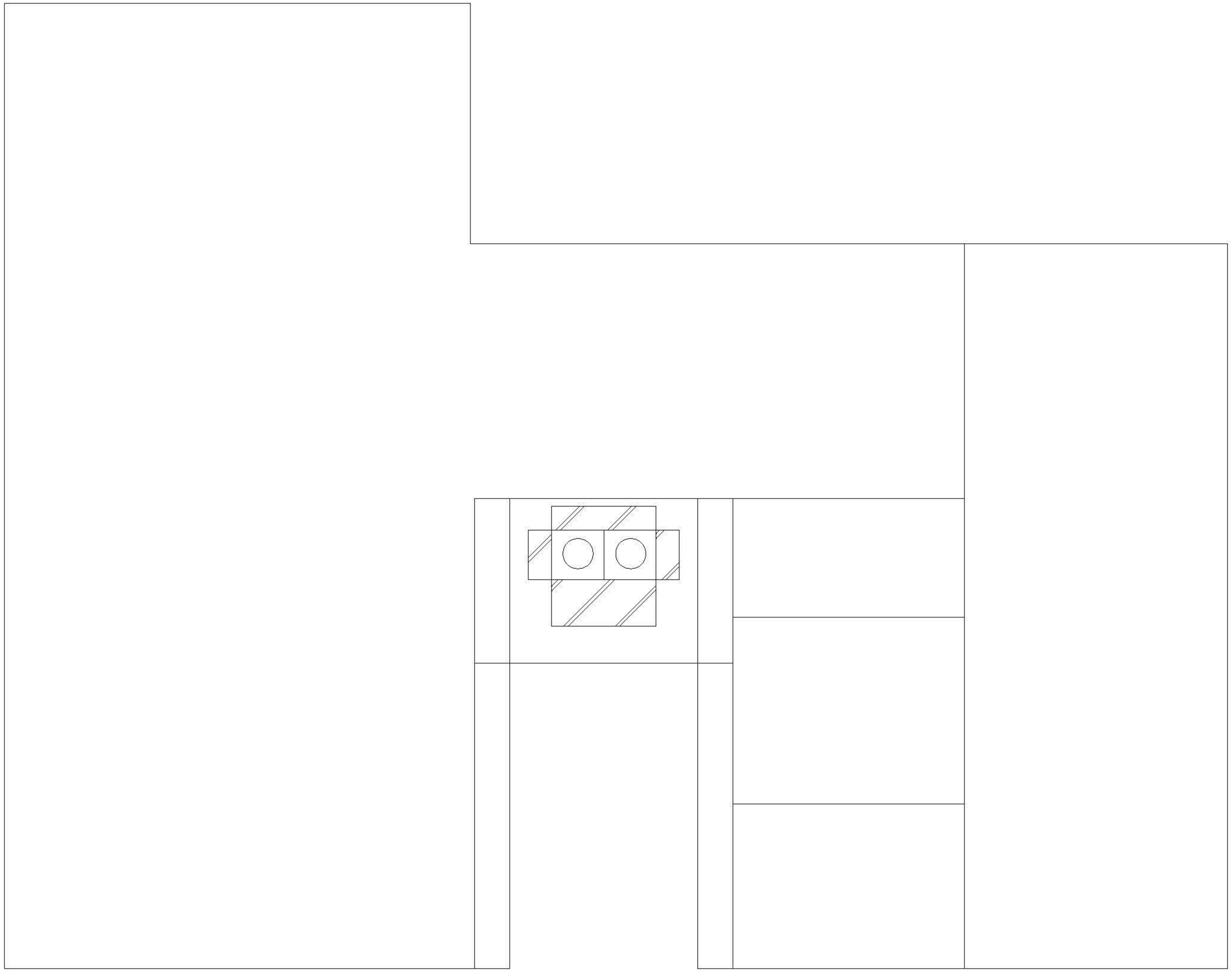
N.T.S.



ASHP REPLACEMENT - UPGRADED SYSTEM

N.T.S.





Appendix G

Estimated Site Electrical Loads

Option		Total thermal (heating) energy required for space heating across site (based on 85 W/m² peak heating load and building specific occupancy schedules) (kW)		Estimated peak LPG demand required for space heating (based on 90% boiler efficiency and 15% system losses)	Estimated peak LPG demand required for DHW (based on 20% of space heating demand and 90% boiler efficiency)	Estimated peak electrical demand required for space heating (based on COP listed in each option and 15% system losses)	Estimated peak electrical load required for DHW (based on 20% space heating load and COP listed in option)	Total electrical load required for Space heating & hot water
		Low heat load spaces / small buildings	High heat load spaces / larger buildings	kW		kW	kW	kW
1	As per original submission. VRF heat pumps and direct electric water heating in low heat load spaces + LPG fired boilers in high heat load spaces	3400	1000	1278	222	1333	680	**2428**
2	VRF heat pumps and direct electric water heating in low heat load spaces with seasonal COP (co-efficient of performance) of 3.6 for VRF heat pumps and Domestic Hot Water (DHW) system efficiency of 100%. DHW load = 20% of space heating demand. Air to water source heat pumps (ASHP) in high heat load spaces with a seasonal COP of 1.8 (includes DHW)	3400	1000	-	-	1987	791	**3193**
3	VRF heat pumps and direct electric water heating in low and high heat load spaces with seasonal COP of 3.6 for VRF heat pumps and DHW system efficiency of 100%. DHW Load = 20% of space heating demand.	3400	1000	-	-	1725	880	**3020**
4	VRF heat pumps and direct electric water heating in low heat load spaces with seasonal COP (co-efficient of performance) of 3.6 for VRF heat pumps and Domestic Hot Water (DHW) system efficiency of 100%. DHW load = 20% of space heating demand. Open loop ground source heat pumps (ASHP) in high heat load spaces with a seasonal COP of 2.5 (includes DHW)	3400	1000	-	-	1804	760	**2978**

wsp.com/nz

GOS 7/7/20
HDEI & CJDS given copy viz.

Hon Ron Mark

Minister of Defence
Minister for Veterans

0 6 JUL 2020

Air Marshal Kevin Short
Chief of Defence Force

Copy: Mark Brunton, Head of Defence Estate and Infrastructure

Copy to: CJDS DEI Please action!

Dear Air Marshal Short 08 JUL

Thank you for all the work you have done in recent months steering the NZDF through a tumultuous period. Thank you too for your ongoing work on the COVID-19 health response.

Despite the trying times, this Government is committed to strong action on climate change. We cannot let our focus on a short-term crisis distract from addressing a longer-term crisis.

In December 2019, the Government created a $200m fund to reduce emissions across the state sector. Many of our schools, hospitals, New Zealand Defence Force (NZDF) facilities and prisons rely on coal or gas boilers, energy intensive incandescent lightbulbs, or outdated and inefficient cooling systems. The State Sector Decarbonisation fund aims to replace these assets with new, low-carbon equipment.

$15m of the State Sector Decarbonisation fund is set aside for upgrading NZDF facilities. $3.84m will go to swapping Burnham Camp's boilers from coal to a low-carbon alternative.

To support the COVID-19 recovery, the Minister of Finance has urged all Ministers to ensure money is getting out the door and into the economy. I would like to see the remaining $11.16m of NZDF funds applied to projects as quickly as possible.

The fund also includes $20m set aside to encourage vehicle fleet electrification. This money can be used to bring the cost of EVs closer to parity with equivalent petrol or diesel vehicles. EECA can provide additional support for fleet optimisation and charging infrastructure.

The Prime Minister recently reaffirmed ambitions for the Government fleet to be entirely emissions-free by 2026/27. It may be that the funding described above can be put to use including EVs in planned NZDF fleet purchases.

If you would like any additional information on the State Sector Decarbonisation fund, or if you have a project that could be suitable, please contact EECA's Public Sector Account Director, Paul Bull. Paul can be reached at paul.bull@eeca.govt.nz or on +64 27 351 2460.

Yours sincerely

RECEIVED OCDF
Date 6/7/20
ID Number 5214

Hon. Ron Mark
Minister of Defence

Hon James Shaw
Minister for Climate Change

Defence Estate and Infrastructure, Headquarters New Zealand Defence Force

HEAD OF DEFENCE ESTATE AND INFRASTRUCTURE MINUTE 106/2021

June 21 s.9(2)(k) [redacted]

s.9(2)(k) [redacted] s.9(2)(k) [redacted] 28/6/21

HEAD OF DEFENCE ESTATE AND INFRASTRUCTURE
Refer Para. 17. s.9(2)(k) [redacted] 30/6.

Endorsed (through: GM FED) s.9(2)(k) [redacted] 28/6/21
Endorsed (through: GM ES) s.9(2)(k) [redacted] 24/6/21
(through: DPMO)
(through: DPP s.9(2)(k) [redacted] 23/06/2021

REQUEST FOR SCOPE CHANGE: BHM ENERGY & ELECTRICAL NETWORK UPGRADE

Purpose

1. The purpose of this minute is to seek approval from Head of Defence Estate and Infrastructure in accordance with DFO 90[1] to change the scope of the BHM Energy & Electrical Network Upgrade project. The intent is remove the electrical elements of the scope related to the High Voltage network, and then consolidate these within the BHM Electrical Network and Resilience Phase 1 project. This will reduce costs, minimise operational disruption, and limit the programme impacts on dependent projects.

Background

2. This project was initiated as two separate projects, both with the aim of replacing key pieces of energy infrastructure at Burnham Military Camp. The BHM Electrical Network Upgrade project was approved in Jan 18[2]. The BHM Energy Centre project was approved in Mar 20[3]. Approval to Commit Funds was granted to the total of $1.237M.

3. The approved option from the Burnham Energy Centre business case was a low emission electrical heating solution. Financial support was to be provided by EECA though a $3.84M grant from the State Sector Decarbonisation Fund. This direction created significant interdependency between the two projects, as the electrical solution requires an estimated 153% increase in peak electrical loading at the camp (2MVA). Correspondingly the requirement for and additional $10.5M investment in electrical infrastructure was noted in the approved Business Case.

4. The two projects were subsequently merged to take advantage of these synergies, with the aim of reducing costs, reducing risk and improving outcomes[4].

---

[1] *DFO 90, Financial Management*, Version 1.00, dated 06 Aug 19.

[2] Burnham Electrical Network Upgrade, Single Stage Business Case (AIP and ACF), dated 01 Jan 18.

[3] Burnham Energy Centre, Single Stage Light Business Case, (AIP and ACF), dated 20 Mar 20.

[4] Project Change Request (Merger), dated 04 Jun 20.

5. The approved scope of works for the combined Burnham Energy & Electrical Network Upgrade project (BHM EENU) was:

a. Upgrade heating systems in buildings currently serviced by the centralised heating plant, with electrical powered VRF or Split Hi-Wall solutions, as required, assessed on a building-by-building basis.

b. Upgrade of transformers, switchboards and pillar-boxes, installation of generators, provision of fuel storage for generators and works in support of the proposed upgrades.

Current situation

6. As design work progressed, it was identified that the existing underground high voltage (HV) infrastructure is near capacity, and is not capable of supporting the EENU, and other projects concurrently in development, such as the Health and Wellness and Consolidated Logistics Projects. Replacement of much of the underground HV cabling will be required to allow these projects to be completed.

7. To ensure that any investment in HV infrastructure would align with the planned redevelopment of the camp, Estate Strategy commissioned a study by Aurecon to model the impacts of projects currently in design, or planned within the next 15 years under the DERP. This information was then used to formulate a high-level concept, which identifies the critical requirements needed to support both current and future development.

8. The intention was to capture these requirements in a future project, the Burnham Electrical Network Priority project, which was planned under the DERP19[5] with express purpose of upgrading the network to accommodate known future demand, and supporting the revised Camp layout. This was originally planned for FY 23/24, but due to the interdependency of these projects was brought forward under a revised title through DERP20[6]. The new Burnham Electrical Network and Resilience Phase 1 project (BHM ENR) has now received ATI and is included in Alliance Work Package 1.

9. It was initially intended that the BHM EENU project would deliver a minimum change solution for the underground infrastructure, sufficient to support the delivery of the project; however, the Aurecon recommendations exceed what was considered, in terms of both capacity and scope. Aligning with these recommendations would require a significant uplift in funding.

10. The concurrent development of the EENU and ENR projects requires a clear delineation of scope; however, it is not currently well defined. Adopting a piecemeal approach would also necessitate significant rework and make construction staging more complicated and disruptive for operations.

11. Alternately, the initiation of both projects creates an opportunity to consider options to gain efficiency by merging the projects. Combining the HV electrical works within a single project will reduce mobilisation and rework costs, and simplify staging thus reducing disruption, and could allow the procurement of a tier 1 civil contractor, reducing risk.

[5] Defence Estate Regeneration Implementation Plan 2019 - 2035, Dated 27 May 19.

[6] Defence Estate Regeneration Implementation Plan 2020 - 2035, Dated 30 Nov 20.

12. A meeting was held between the project teams to discuss the options and identify a way forward. The Planning Officer for the BHM ENR project has agreed to take on additional scope, subject to HDEI approval.

13. As a result, the investment of $1.980M that was approved through the BHM Electrical Network Upgrade project[7] and the $9.400M approved through the BHM Energy Centre project[8] could be reaffirmed through new business cases.

Financial and resource implications

14. Three options for the BHM Energy & Electrical Network Upgrade project have been considered:

a. **Option 1**: Continue with existing project structure; increase the EENU scope to allow concurrent development of both projects. This will be more costly due to the rework required and more disruptive for operations during delivery.
Energy & Electrical Network Upgrade forecast ROC $30.637M, WOLC $30.186M.
Electrical Network & Resilience forecast VROC $12.300M WOLC $13.255M.

b. **Option 2**: Combine both projects. The large size would make the project more attractive to tier 1 contractors, but the complex programme would likely impact the schedule of other dependent projects such as CLP.
Energy, Electrical & Resilience forecast VROC $41.396M WOLC $41.987M.

c. **Option 3:** Consolidate the HV electrical works into a one project, leaving the Energy project as a standalone. This will simplify staging, reducing disruption, and will likely create further savings by reducing mobilisation and rework costs.
Electrical Network Upgrade & Resilience forecast VROC $22.996 WOLC $24.781M.
Energy Centre Replacement forecast ROC $18.4 WOLC $17.205M.

15. **Preferred option:** Option 3 is the preferred option because it will reduce costs, eliminate rework, minimise operational disruption during construction, and limit the programme impacts on dependent projects.

16. Option 3 will:

a. Simplify staging, reducing operational disruption during construction;

b. Enable the delivery of long-term solutions, removing the need for temporary steps and eliminating costly rework;

c. Improve efficiency by reducing the cost of mobilisation and enabling works;

d. Increase the scale of work to a size consummate with the procurement of a tier 1 civil contractor, providing greater cost efficiency and reducing risk;

e. Provide additional flexibility in delivery that could to allow coordination with the concurrent BHM Potable Water Network and Storage, and BHM Waste Water Network projects, reducing overall costs; and

f. Limit the programme impact on dependent projects by simplifying the approval, procurement and construction timelines.

[7] Burnham Electrical Network Upgrade, Single Stage Business Case (AIP and ACF), dated 01 Jan 18.
[8] Burnham Energy Centre, Single Stage Light Business Case, (AIP and ACF), dated 20 Mar 20.

Recommendation

17. It is recommended that Head of Defence Estate and Infrastructure:

Noted s.9(2)(k) a. **note** that the electrical costs indicated above are based on the $10.695M ROC estimated from the BHM ENNU electrical preliminary design, and the $12.300M ATI value of the BHM ENR project.

Noted s.9(2)(k) b. **note** that the BHM Energy project costs are based on the $18.400M ROC derived from the BHM EENU mechanical developed design;

Noted s.9(2)(k) c. **note** the $1.980M approved through the BHM Electrical Network Upgrade business case and the $9.400M approved through the BHM Energy Centre light business case will be reaffirmed through two new business cases; and

Approved. s.9(2)(k) 30/6. d. **agree** to approve option 3 above, the consolidation of all planned HV electrical works at Burnham Camp within a single 'Electrical Network Upgrade & Resilience' project.

s.9(2)(k)

s.9(2)(g)(i)

MR

PLANNING OFFICER

Enclosures:

Encl. 1: BHM Electrical Options Whole of Life Cost Assessment Summary, dated 1 Jun 21.

Project Number: 6-ME947.00

Burnham Military Camp

Energy Centre Replacement Project Mechanical Building Services

Detailed Design Features Report

5 September 2022

Contact Details

Jason Bretherton

WSP
12 Moorhouse Avenue
Christchurch 8011
s.9(2)(a)
[redacted]

Document Details:

Date:	5 September 2022
Reference:	6-ME947.00
Status:	Rev 3

Prepared by

Chris McFadden - Mechanical Engineer

Reviewed by

Bernhard Schmiedeke – Senior Mechanical Engineer

Approved for release by

Jason Bretherton - Technical Director, Buildings

Document History and Status

Revision	Date	Author	Reviewed by	Approved by	Status
Rev 1	15 January 2021	s.9(2)(a) [redacted]		Jason Bretherton	
Rev 2	5 April 2022			Jason Bretherton	
Rev 3	5 September	Chris McFadden	Bernhard Schmiedeke	Jason Bretherton	Detailed Design

Revision Details

Revision	Details
Rev 1	Draft – initial release
Rev 2	Amendments in response to Client feedback
Rev 3	Detailed design

Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for the Chief of Defence Force ('**Client**') in relation to Burnham Military Camp Energy and Electrical Network Upgrade Project ('**Purpose**') and in accordance with the Professional Services Contract and associated Statement of Works. The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

In preparing the Report, WSP has relied upon data, surveys, analyses, designs, plans and other information ('**Client Data**') provided by or on behalf of the Client. Except as otherwise stated in the Report, WSP has not verified the accuracy or completeness of the Client Data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this Report are based in whole or part on the Client Data, those conclusions are contingent upon the accuracy and completeness of the Client Data. WSP will not be liable in relation to incorrect conclusions or findings in the Report should any Client Data be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WSP.

Contents

Appendices

1 Executive Summary

This Detailed Design Features Report develops the options discussed in the Concept Design, Preliminary Design and Developed Design Summary Reports

1.1 List of Changes

Following an earlier DFR and Developed Design release, a design review was conducted by the Client to provide enhanced value solutions. A high-level summary of the changes made to the Developed and Detailed Designs since the original issue is outlined below:

1. Building audits have been carried out for buildings that have existing heating solutions that operate independently from the central energy plant and are in adequate condition for continued use. These buildings were identified by the Client in a workshop held on site and inspected in subsequent site visits. Where available the end users of each space have been consulted to establish efficient, fit-for-purpose solutions for each space. This has led to a reduction in new heat pumps proposed for several spaces, either because existing units can remain operational or because the end user has stated that no heating is required in certain zones.
2. One example of a major reduction in scope brought on by Client feedback is the A61 Q-Store area, where a new internal wall will be constructed to drastically limit the actively heated area in that building. This allows a large reduction in heating capacity while providing improved comfort in the occupied zones.
3. Where possible, several smaller heatpumps have been consolidated into fewer larger models. This reduces the capital costs of heating systems for large rooms. Potential downsides (less even heating, less occupant comfort) have been considered in dialogue with the Client.
4. The number of grilles (inlet and outlet) have been reduced and duct runs have been simplified for packaged air handling solutions in larger buildings such as the B53 Officer's Mess Hall. This enables a cost save on material and installation labour costs.
5. The B67 Barracks have been selected to be fully designed and installed first as a pilot to inform design and budget decisions for the other barracks buildings. The design has been adjusted to optimize site installation of pipe runs. Updated pricing has been provided for the installation of the HVRF system in the B67 Barracks.
6. The D04 Conference Centre has changed from retaining the existing radiators and installing a high temperature air source heat pump to a VRF system. This is to provide cooling, as well as heating, due to overheating of the building during summer months.
7. The E04 plantroom which provides heating and domestic hot water to parts of the E block has changed from an LPG boiler to a high temperature air source heat pump (ASHP). When the E block is decommissioned this ASHP can be utilised elsewhere to provide efficient water and space heating.
8. Pricing estimates provided in 2021 have been updated to reflect the increased material and equipment costs caused by the Covid-19 pandemic.

1.2 Heating/ Air conditioning types developed are as follows:

1. Direct refrigerant eXpansion (DX): Unless by exception below, all buildings up to 20 kW heating load.
2. HVRF (Hybrid Variable Refrigerant Flow): Unless by exception below, all buildings over 20 kW heating load, including barracks. This was the preferred option of the Client from the

Preliminary Design Features Report, principally due to the poor condition of existing heating recirculation pipework serving radiators which precluded the use of air source heat pumps, with the added benefit of HVRF providing cooling.

3 Exception: ASHP (Air Sourced Heat Pump): ASHP is used for the C58 Gymnasium, where the existing field equipment and piping is in relatively good condition. It is also used in the E04 Medical Plantroom building serving the E block buildings in the short term only, as they are due to be decommissioned within the next few years.

4 Exception: PAC (Packaged Air Conditioner AHU): Packaged Air Conditioners are proposed for B53 B Block 600 person mess building

5 Exception: VRF (Variable Refrigerant Flow): VRF systems are proposed for building B59 Warrant Officers and Sergeants Mess and building D08 Camp Cinema – which previously were proposed to have PAC systems, and also building D04 which previously was proposed to have an ASHP system. The VRF system is more cost effective than the PAC system and suitable for buildings containing larger air conditioned rooms. The VRF system has the benefit of providing cooling as well as heating where the ASHP can only provide heating.

6 Exception: Electric Radiant Heating or temporary Indirect LPG or Diesel Heaters: Electric radiant heating is proposed for warehouses and workshop type buildings. These buildings are either earmarked for demolition (mostly by 2025), have intermittent usage, or are high ceiling or drafty spaces where radiant heating is required.

While Direct electric heating has a lower efficiency (COP =1) than refrigerant based solutions, it also has significantly lower capital cost. The benefit of radiant electric heating is that it can achieve spot heating and comfortable working conditions when and where required.

The following buildings have been progressed with direct electric heating;

(a) A62: Q Store Armoury
(b) F12: 3rd Combat Service Support Battalion Quartermaster Store

For the buildings planned to be demolished mostly by 2025, the Client is looking at using temporary heating solutions based on mobile indirect LPG or Diesel heaters, eliminating the costs large electrical infrastructure upgrade required for electric radiant heaters. The following buildings have been progressed with temporary mobile indirect LPG or Diesel heating;

(a) Z01: Vehicle Services Workshop / Weapons ET Section
(b) Z02: 3 Workshop Electrix
(c) Z03: GE Workshop / Autoparts
(d) Z62: Workshop Building

2 Scope of this Detailed Design Report

The scope of this Detailed Design Features Report includes;

1 Options Progressed: How options from the Preliminary Design Features Report were selected and progressed through to DetailedDesign
2 BMS and HVAC Control Strategies.
Utility Requirements, Schedule of Building Features: The Schedule of Building Features appended to the Detailed Report has been updated to include electrical utility requirements for HVAC equipment and Domestic Hot Water (DHW).

3 Options Progressed in Detailed Design

This section assumes the reader is familiar with the options put forward in the Concept and Preliminary Design report, including discussion on relative advantages and disadvantages, efficiencies and carbon footprints.

3.1 Default Option for Buildings up to 20 kW Heating Load – Direct eXpansion (DX) Refrigerant Systems

In line with the Preliminary Design Features Report, buildings up to 20 kW heating load have progressed to Detailed Design as DX heating systems as the default option, as the most economic capital / running cost option for electric based heating in this capacity range.

The condition of existing DX systems in each building have been assessed and where possible they will be retained, leading to a significant reduction of new DX split systems required.

Where possible, several smaller heatpumps have been consolidated into fewer larger models. This reduces the capital costs of heating systems for large rooms. Potential downsides (less even heating, less occupant comfort) have been considered in dialogue with the Client.

Small spaces are served by single splits, with larger buildings within this capacity band being serviced by multi splits.

This option has the added advantage of providing cooling.

Where buildings have had to vary from this default option, they are detailed by exception in the sections below.

3.2 Default Option for Buildings over 20 kW Heating Load – Hybrid Variable Refrigerant Flow (HVRF) Systems

The Preliminary Design Features report discussed 3 general options for these larger buildings;

(a) Single air source heat pump: This option considered a single air source heat pump per building capable of producing 75°C water to feed directly into existing building comfort heating and calorifier networks. This option made the most use of existing infrastructure, but ultimately still had the highest capital cost (air source plant which can generate at 75°C is expensive) and the highest running costs (air source heat pumps producing at 75°C have low efficiencies). The option was further discounted when it was found that most building heating pipework systems are in poor condition requiring unspecified repair prior to re-use.

(b) Dual temperature air source heat pump: This option considered splitting air source heat pumps into two units, with a larger unit producing efficiently at 50°C for comfort heating and smaller unit producing at 75°C for domestic hot water demand only. New radiators would have been required in order to operate at the lower 50°C temperature, requiring minor work in occupied spaces. This option had the highest efficiency and was the middle capital cost option, however was ultimately discounted when it was found that most building heating pipework systems are in poor condition requiring unspecified repair prior to re-use.

(c) HVRF systems: This option was put forward as an option with medium efficiency. HVRF is the only option which provides cooling but will require significant work inside occupied spaces, for the installation of indoor units, sensors, power and water reticulation.

In consultation, the Client has elected to proceed with HVRF as the default option for buildings over 20kW heating load.

The B67 Barracks have been selected as a pilot to be fully designed and installed first to inform design and budget decisions for all other barracks buildings. The design has been adjusted in detail to optimize site installation of pipe runs. Updated pricing has been provided for the installation of the HVRF system in the B67 Barracks

3.3 Design Exceptions

Where buildings have had to vary from the above default option, they are detailed by exception in the sections below.

3.3.1 Exception: Variable Refrigerant Flow (VRF)

VRF systems are proposed for building B59 Warrant Officers and Sergeants Mess, building D08 Camp Cinema and D04 Conference Centre – which previously were proposed to have PAC systems or Air Source Heat Pumps. The VRF system is more cost effective than the PAC, HVRF and ASHP systems and suitable for buildings containing larger air conditioned rooms.

3.3.2 Exception: Air Source Heat Pump (ASHP)

High temperature Air Source Heat Pumps are used for the C58 Gymnasium building and E04 Medical Facilities Plantroom, where the existing field equipment and piping is in reasonably good condition.

The high temperature heat pumps are able to supply heating water at 80~85 °C, temperatures similar to a classic boiler. It is a new and rapidly evolving market with few suppliers offering reliable, NZ supported equipment. The specified heat pumps became available in NZ in 2021 and are suitable for serving these two buildings.

3.3.3 Exception: Packaged Air Conditioning Air Handler Unit (PAC-AHU)

Per discussion in the Preliminary Design Features Report, PAC-AHU is proposed for building B53 B Block 600 person mess which is a large open plan building that require high air flows;
PAC systems initially proposed for other buildings have changed to more cost effective systems types as shown below

(d) B59: Warrant Officers and Sergeants Mess – changed from PAC to VRF System
(e) D04: Camp Conference Facility – changed from PAC to VRF to provide heating and cooling capabilites.
(f) D08: Camp Cinema – changed from PAC to VRF System

3.3.4 Exception: Electric Radiant Heating or Temporary Indirect LPG or Diesel Heaters.

Per discussion in the Preliminary Design Features Report, electric radiant heating is proposed for warehouses and workshop type buildings.

These buildings are either earmarked for demolition (mostly by 2025), have intermittent usage, or are high ceiling or drafty spaces where radiant heating is required.

While Direct electric heating has a lower efficiency (COP =1) than refrigerant based solutions, it also has significantly lower capital cost. The benefit of radiant electric heating is that it can achieve spot heating and comfortable working conditions when and where required.

Radiant heating is also necessary in high ceiling or drafty spaces.

The following buildings have been progressed with direct electric radiant heating;

(a) A62: Q Store Armoury
(b) F12: 3rd Combat Service Support Battalion Quartermaster Store

For the buildings planned to be demolished mostly by 2025, the Client is looking at using temporary heating solutions based on mobile indirect LPG or Diesel heaters, eliminating the costs of significant electrical infrastructure upgrade required for electric radiant heaters.

The following buildings have been progressed with mobile indirect LPG or Diesel heating;

(a) Z01: Vehicle Services Workshop / Weapons ET Section
(b) Z02: 3 Workshop Electrix
(c) Z03: GE Workshop / Autoparts
(d) Z62: Workshop Building

4 Building Management System (BMS) and HVAC Controls Strategies

4.1 Control and BMS Infrastructure Options

This section should be read in conjunction with the Building Management System Report Rev 1 issue date 15 January 2021.

A BMS is not essential for day-to-day control of mechanical systems, if building Programmable Logic Controllers (PLC's) are provided at each building;

1 Most equipment is provided with integral controllers to which field sensors are connected to allow their normal operation, e.g., HVRF systems are provided with integral controls, with the indoor units and room temperature sensors connected to the outdoor unit.
2 A local building or 'zone' Programmable Logic Controller (PLC) is normally provided at each MSSB to allow time clock functions to be set globally for the building, and to allow equipment within the building to operate together, e.g. all equipment will stop when the building is scheduled to be unoccupied, kitchen supply fans will operate whenever the kitchen extract operates, etc.
3 This local control is in any case preferable to central BMS control in case network connection is lost, allowing local systems to continue to operate. Best practice is to use the site BMS only to monitor, log and change set points, rather than to provide control functionality to remote plant.

A BMS is essential if the Client wishes to;

1 Monitor the mechanical systems for faults, and easily re-set faulted equipment.
2 Easily adjust set points or schedules, including scheduling the shutdown of a building when unoccupied.
3 Monitor trends and make adjustments to achieve better energy efficiencies.
4 Etc.

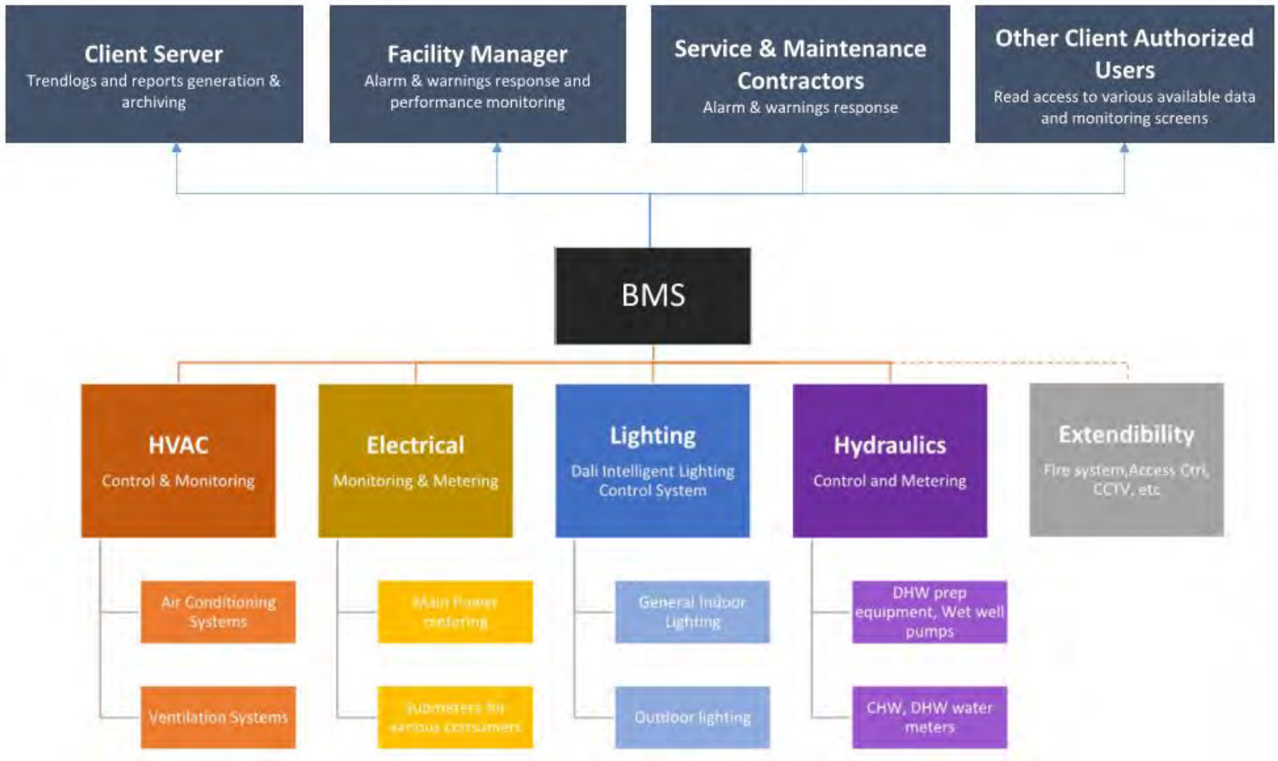
The existing site BMS network is only extended to ~20 buildings by cable, and the front end is understood to have inadequate capacity for all of the proposed new HVAC systems.

We propose a staged controls / BMS strategy for this site heating project which will allow the Client to progress based on affordability;

1 At a minimum, provide PLC's at each building MSSB to provide local control functionality, and to receive all local run / fault and space temperature information.

2 If and when affordable, connect these 'zone PLC's' to a new central BMS, either via a cabled or radio transmitter network. This is highly recommended to allow the efficient operation and monitoring of the site, and would preferably be installed as part of these contrct works.

A complete BMS network, including integration of other building services such as electrical and lighting, may follow the diagram below;



4.2 Existing BMS System

The BMS is a Schneider Electric EcoStruxure system that controls the heating system for about 20 buildings. Another 6 buildings have standalone controllers.

The Building Management System Report gives a detailed description of existing BMS expanse and functions.

However due to the changes of the Mechanical Services, the BMS existing functions become unusable. The only parts of existing BMS that may be reused are the controller hardware and the control wiring.

4.3 HVAC control strategies

The control strategies presented below for each type of system shall be progressed as Functional Descriptions during the Detailed Design phase.

4.3.1 DX Split and Multisplit Units

The units shall operate on programable time schedule with afterhours push button on timer (typically one hour). A BMS can monitor and log the units operation hours.

4.3.2 HVRF and ASHP Systems

HVRF and ASHP systems have their own proprietary controls and shall be connected by BACNET to the BMS.

Typically, all HVRF and ASHP operating parameters, warnings and alarms become available for monitoring and trend logging via a BMS. A number of setpoints can be remotely controlled via a BMS.

4.3.3 PAC Systems

PAC systems can be controlled by a local PLC controller and connected to a BMS server via BACNET. The control system programming shall allow for free cooling using variable rates of outdoor air.

4.3.4 Direct Electric Radiant Heating Systems

Radiant heating systems have a low energy efficiency. Significant energy savings can be achieved by operating where and when required only.

Electric Radiant Heating systems typically are controlled using local proprietary control equipment (controller, sensors, actuators).

The temperature is controlled based on surface (floor) temperature readings by a specialist infrared sensor.

For spaces with intermittent or rare occupancy presence sensors are used for starting/ stopping the radiant heating.

5 Layouts, Schematics and Plant Schedules

In Detailed Design WSP has selected all major equipment and indicated utilities and spatial requirements.

Layouts, Schematics and Equipment schedules are shown for each building in the Detailed Design drawing set.

Major piping and ducting types and routes are shown on the Detailed Design drawings.

6 Utility Requirements

Electric power requirements for each building are shown in the Schedule of Building Features in Appendix E.

These figures shall be interpreted as total installed electric load of HVAC and DHW equipment.

1. The total electric load for HVAC equipment is 1.40 MW
2. The total electric load for DHW equipment is 0.37 MW

The estimated diversity factor at site level ranges between 50% and 66%, being influenced by how the HVAC systems are operated by the Client.

The Electrical Design will reflect lower diversified loads as calculated by the Electrical Engineer, rather than the total installed loads in the Mechanical Design.

Appendix A

Proposed Site Layout

s.6(a)

[redacted]

Appendix B

Schedule of Building Features

APPENDIX B

s.6(a)

[redacted]

s.6(a)

[redacted]

APPENDIX B

s.6(a)

[redacted]

APPENDIX B

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Defence Estate and Infrastructure

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25 Jan 23

s.9(2)(k) [redacted] 26/1/23.

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s.9(2)(k) [redacted] 26/01/23

s.9(2)(k) [redacted] 24/1/23

BURNHAM ENERGY CENTRE REPLACEMENT PROJECT CO-FUNDING – OPTIONS TO PROCEED

Reference

A. Letter Minister of Defence to HDEI, 6 July 2020.

B. EECA Collaboration Agreement, VOC2 State Sector Decarbonisation Funding Tranche 2, 27 October 2020.

C. Leading the Way: Establishing a Carbon Neutral Government Programme, CAM-20-MIN-0491, December 2020.

Purpose

1. The purpose of the Minute is to seek HDEI approval of the preferred option to proceed under the State Sector Decarbonisation Fund (SSDF), for the Burnham Energy Centre Replacement (ECR) Project.

Background – Carbon Neutral Government Programme (CNGP)

2. The Carbon Neutral Government Programme (CNGP) was introduced by Minister of Climate Change and Minister of Economic and Regional Development in December 2020. This included a requirement for each agency to:

a. measure, report and verify carbon emissions;

b. set reduction targets and plans;

c. optimise and transition the government fleet to electric vehicles;

d. phase out coal boilers, prioritising the largest, most active coal boilers by 2025 (estimate for state sector coal boiler emissions was 37 kT CO_2e in 2020);

e. rate government offices for energy efficiency;

f. reduce emissions from new government buildings; and

g. offset emissions (TBC – a future policy) to reach carbon neutrality by 2025.

3. To support the CNGP work, Minister of Defence and Minister for Climate Change issued a letter to NZDF outlining a notional allocation under the State Sector Decarbonisation Fund (SSDF) of $15.00M for NZDF facilities. This has since been reduced to $9.00M and with the remainder re-allocated across the Government portfolio.

4. The SSDF is focused on replacing fossil-fuelled boilers with low emissions alternatives, replacing vehicle fleets and installing energy efficient chillers and LED lighting. The SSDF is administered through the Energy Efficiency and Conversation Authority (EECA). NZDF accesses the SSDF through variation to the NZDF and EECA Collaboration Agreement.

Background – Burnham Coal Boiler

5. The Burnham ECR project aims to replace the existing end-of-life central coal boiler and steam network at Burnham, with new decentralised low-emission solutions, predominantly using electric heat pumps.

6. The project has an approved Business Case, which received AIP of $9.40M in March 2020[1]. The submission was based upon a Concept Design, supported by a very rough order of cost estimate using square metre rates derived from small electrification projects already completed at Burnham.

7. Based on the Concept Design, NZDF submitted a request to the SSDF for co-funding the Burnham ECR project. The SSDF co-funding was approved at $3.84M (40% of Concept Design estimate). This agreement has an annual carbon abatement target of 4,860 T CO_2e, with practical completion being the final milestone to drawdown the co-funding, by 30 June 2025.

8. Developed Design was initially completed in January 2021, with construction cost estimated at $18.90M. A peer review and value engineering was undertaken. Any savings generated were offset by escalation and supply constraints. The revised Developed Design received Design Gate 2 endorsement in May 2022[2], with a forecast construction cost of $18.70M.

9. Detailed Design for the Burnham ECR project has been completed. Cost estimation was moved to the DEI Alliance to improve the consistency of reporting and to support the programmisation of capital works at Burnham. The move incudes a change in methodology, from the estimation of only direct construction costs with exclusions, to an estimation of the total out-turn cost, which includes allowances for known unknowns, such as escalation, supply constraints and contamination management costs. This approach has indicated a forecast project cost of $39.6M at Detailed Design.

Background – Dependencies

10. The Business Case noted that the move to an electrical solution would necessitate an upgrade of the electrical network at Burnham. This was initially progressed as a part of the Burnham ECR project, but later established as a separate project (the Burnham Electrical Network and Resilience project) once the scale of work was identified.

11. The Burnham Electrical Network and Resilience project was included in a programme of horizontal infrastructure projects. This project aims to upgrade Burnham's electrical network to support current and future military capabilities. The project has reached Detailed Design, receiving Design Gate 3 endorsement in July 2022[3]. The draft of the Business Case is complete, with submission pending confirmation of funding availability.

12. A submission was made through the budget process to seek capital injection of $110.0M as a contingency to offset cost pressures faced by DERP projects in Detailed Design. Following prioritisation, the submission is below the line and will not be carried forward this financial year.

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[1] 7630-7-BHM Burnham Energy Centre Single Stage Light Business Case, dated 20 Mar 20

[2] Endorsement of the Developed Design for BHM Energy Centre Replacement Project, dated 3 May 22

[3] Endorsement of the Detailed Design and Single Stage Light Business Case for the Burnham Electrical Network & Resilience project, dated 20 Jul 22.

13. The resulting shortfall in forecast funding necessitated a reprioritisation of the Capital Plan to ensure the co-ordinated delivery of dependent projects. This required funding for the programme of horizontal infrastructure projects to be moved to 2023/24, a delay in construction of 6-9 months.

14. This impacts the Burnham ECR project, as the upgrade of the electrical network is required to power much of the new plant and equipment, with delivery of the Burnham ECR project ideally staggered six months behind each stage of the electrical upgrade. As a result the project cannot practicably meet the SSDF milestone (refer para 7), with completion now likely to be 2028/29.

Options – Options to Proceed

15. NZDF has been open and transparent with EECA about the current status of the Burnham ECR project, and, together, we have identified three options that we can pose to NZDF and the Climate Change Ministers.

Criteria	**AGREEMENT (Baseline)**	**OPTION 1 (preferred)**	**OPTION 2 (not viable)**	**OPTION 3 (least palatable)**
Title	Burnham ECR project	Stage the project	Request more funding	Withdraw from SSDF
Timeline	30 Jun 25	1: deliver by 30 Jun 25 2: dependency work 3: deliver by 30 Jun 29	Deliver by 30 Jun 25	Defer start to FY27/28 Completion FY29/30
Funding (Escalated)	SSDF: $3.84M DERP: $35.733M OPEX: ($8.150) WOLC: $37.631M	SSDF: ≥$3.84M DERP: $30.439M OPEX: ($6.945) WOLC: $29.996M	SSDF: $15.84M DERP: $30.618[4]*M OPEX: ($8.150) WOLC: $33.943M	SSDF: $0 DERP: $36.023M OPEX: ($2.486) WOLC: $32.993M
Carbon Abatement (Annual)	4,860 T CO_2e	1: 1,132 T CO_2e 3: 4,860 T CO_2e	4,860 T CO_2e	4,860 T CO_2e
SSDF $ / T CO_2e	$790.12	$3,392.23	$3,259.26	$0
Other Impact	Deferral of other projects	Request top-up SSDF funding	Army disruption Diesel generators Industry capacity	

Table 1 – Summary of Options to Proceed

16. **OPTION 1: Stage the project**. Split the project into three stages and reduce agreed scope (stage 1 only) under SSDF:

a. stage 1 will deliver upgrades that can be completed within the constraints of the existing infrastructure and the approved budget of $9.40M. This will upgrade 15% of the subject buildings, reducing the loading on the Burnham coal boiler to achieve a reduction in emissions of 1,132 T CO2e, or 23.3% of the SSDF agreed carbon abatement target;

[4] Includes allowance for offsite accommodation costs

b. stage 2 is the phase of inaction due to dependence work on electrical network being undertaken; and

c. stage 3 will deliver upgrades to remaining buildings, beginning in 2027/28, enabling the existing coal boiler to be shut down in 2028/29.

If endorsed, this will allow NZDF to retain (and/or request a top-up to) the $3.84M SSDF co-funding. Extending the programme will better support prioritisation of depreciation funds, allowing the removal of up to 16 buildings from scope as the replacement facilities are completed, and will allow sequential upgrade of barracks, reducing the operational impact on Army.

Note as NZDF will be required to offset carbon emissions from 2025/26 (refer para 2g), the estimated offsetting impact through staging is $0.40M per annum.

17. **OPTION 2: Request More Funding.** Seek additional SSDF co-funding to enable construction to be completed before the fund closes on 30 Jun 25. The additional funding would be requested up to 40% of the Detailed Design cost estimate, or up to an additional $12M, from the SSDF. However this approach has a number of caveats;

a. **Note** the additional SSDF funding would free up future The project must be delivered before the electrical network upgrade can be completed, requiring diesel generators to be used to support the shortfall in electrical capacity;

b. The compacted programme requires that barrack block upgrades are intensified; three blocks would be shut down simultaneously for the duration of the programme with personnel decanted to off-site commercial accommodation at significant cost;

c. This approach requires the project to be delivered concurrently with a nine other capital projects, including three Camp-wide horizontal infrastructure replacement projects, plus new medical, maintenance and training facilities. This would compound the level of disruption, further complicate access to site and the allocation of set down space for equipment storage and contractor parking;

d. Several buildings that are scheduled for replacement will require temporary heating solutions until they can be replaced; and

e. Completing the project on time means that other projects prioritised through the capital plan will need to be deferred to free up depreciation funding so that this project can be delivered with the required timeframe.

Note the additional SSDF funding would free up future depreciation funding to allow for the early delivery of other projects outline in the capital plan.

Note this option will significantly increase operational disruption for Army, and is likely to impair the delivery of operational outputs. The option is not viable for this and the above reasons.

18. **OPTION 3: Withdraw from SSDF.** Formally withdraw the Burnham ECR project from the SSDF allocation, and return any funding appropriated so far. This will defer the project until 2027/28, and allow the sequential upgrade of electrical network and barracks to reduce the operational impact on Army.

Note withdrawal from the SSDF requires endorsement from the Minister of Defence (and the Climate Change Ministers). This will require NZDF to contribute an additional $3.84M to the project, and to offset carbon emissions from the coal boiler until the project is completed, at a cost of approximately $0.50M per annum.

Recommendation

19. It is requested that DEI LT:

Discussed & Agreed LT Mtg 24/01/23

a. **Discuss** the options presented:

(1) Option 1: stage the project and request reduced scope under SSDF co-funding agreement.

(2) Option 2: request increase in SSDF co-funding up to 40%, to accelerate programme to meet 30 Jun 25 deadline.

(3) Option 3: withdraw from SSDF co-funding agreement.

20. It is recommend that HDEI:

Approved.

a. **Approve** option 1 as recommended option to proceed, pending confirmation from EECA, Climate Change Ministers and Minister of Defence.

s.9(2)(k) [redacted]

26/01/23.

s.9(2)(k) [redacted]

DR LEE BINT
Director Sustainability

DTelN s.9(2)(k) [redacted]

s.9(2)(k) [redacted]

s.9(2)(g)(i) [redacted]
Planning Team Lead

DTelN s.9(2)(k) [redacted]