THE CITY OF EDMONTON
DESIGN-BUILD AGREEMENT
CAPITAL LINE SOUTH LRT EXTENSION PHASE 1

Schedule 5 – D&C Performance Requirements

Part 7: Operations and Maintenance Facility

[NTD: Schedule 5 D & C Performance Requirements – all parts – will be amended July 30 2024 to reflect requirements associated with Appendix A - Affordability Opportunities Amendment Term Sheet]

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PART 7: OPERATIONS AND MAINTENANCE FACILITY

SECTION 7-1 – DESCRIPTION OF INFRASTRUCTURE

7-1.1 GENERAL REQUIREMENTS

A. The Llew Lawrence OMF will serve as an operational base for the marshalling of trains and the maintenance of LRVs and must include the following Infrastructure to be Designed and Constructed by Design-Builder to provide the following high floor LRT network related functions:

1. operational functions and fleet management requirements, including, but not limited to, fleet size and servicing, yard capacity, rail transportation, LRV storage, right-of-way maintenance equipment storage and material storage;

2. scheduling, monitoring and management of operations and maintenance activities to achieve the requirements set out in Appendix 5-1B [*High Floor Operations and Maintenance Parameters*] of this Schedule;

3. routine and light maintenance of LRVs and ROW maintenance equipment;

4. staging of LRVs and other on-track vehicles;

5. LRV servicing, LRV exterior washing (including undercarriage and overhead), LRV interior cleaning; and

6. any other Project related functions specified to be located at or performed from the Llew Lawrence OMF.

B. Reference Design data for the Ultimate Buildout of the Llew Lawrence OMF is provided in the Disclosed Data for information to the Design-Builder.

C. Design-Builder must Design and Construct the Llew Lawrence OMF in accordance with the requirements of Part 7 [*Operations and Maintenance Facility*] for the buildings, yard and Site development, and must take all reasonable steps necessary during the Design and Construction of Llew Lawrence OMF to protect for and reduce costs of the Ultimate Buildout.

7-1.2 DEVELOPMENT APPROVALS

A. The City has submitted a shadow development permit application (458546522-002) for the Llew Lawrence OMF. The Design-Builder must comply with all conditions of the shadow development permit (application). Refer to Appendix 5-7D *[Shadow Development Permit]*.

B. The Design of the Llew Lawrence OMF must consider and implement feedback from the EDC as described in Section 2-6 [*Edmonton Design Committee (EDC)*] of this Schedule.

C. A Memorandum of Agreement (MA) will define the requirements for the Design and Construction of the off-site municipal infrastructure required to service and provide access to the Llew Lawrence OMF Site, including water mains, storm and sanitary sewers, paved roads, sidewalks, curb and gutter, power, and street lighting. The MA will require the Design-Builder to prepare and submit detailed engineering for the off-site municipal infrastructure for review and approval under the process described in the D&CS and the MA. The MA will require the Design-Builder to apply for and obtain independent Construction Completion Certificates (CCCs) for the improvements identified in the MA, provide a warranty for periods of time defined in the MA, then apply for and obtain Final Acceptance Certificates (FACs) for the improvements identified in the MA.

SECTION 7-2 – REFERENCE DOCUMENTS

7-2.1 REFERENCE DESIGNS

A. Reference Design data for the following is provided in the Disclosed Data for information only:

1. Llew Lawrence OMF Stage 1
2. Ultimate Buildout of Llew Lawrence OMF

7-2.2 APPLICABLE CODES, REFERENCE STANDARDS AND GUIDELINES

A. Without limiting Section 7-2 [*Reference Documents*] of this Schedule, and except as otherwise specified herein, the Design and Construction of the Llew Lawrence OMF and associated equipment, components, materials, systems, and sub-systems must comply with the following codes, reference standards and guidelines:

1. ANSI/BICSI N2-17 - PoE Installation
2. ANSI/EIA/TIA TSB 67 - Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems
3. ANSI/EIA/TIA TSB 72 - Centralized Optical Fiber Cabling Guidelines
4. ANSI/EIA-568-C.2 - Standard for Twisted Pair Cabling
5. ANSI/NECA/BICSI 568 - Standard for Installation Commercial Building Telecommunications Cabling
6. ANSI/NECA/BICSI 607 D - Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
7. ANSI/TIA-526-7 - Measurement of Optical Power Loss of Installed Single-Mode Fibre Cable
8. ANSI/TIA-568.2-D - Balanced Twisted-Pair Telecommunications Cabling and Components Standard
9. ANSI/TIA-568.3-C - Optical Fibre Cabling and Components
10. ANSI/TIA-569-C - Telecommunication Pathways and Spaces
11. ANSI/TIA-598-C.2 - Colour Coding of Fibre Optic Cables
12. ANSI/TIA-607-D - Telecommunication Grounding and Bonding
13. ASTM 6165 - Standard practice for determining rail-to-earth resistance
14. ASTM C1202 - Standard test method for electrical Indication of concrete’s ability to resist chloride ion penetration
15. BS EN-50122-1 - Railway Applications - Fixed installations
16. BS EN-50162 - Protection against corrosion by stray current from direct current systems
17. Building Industry Consulting International (BICSI) TDM Manual
18. CAN/CSA C22.2 No.182.4M90(R1996) - Plugs, Receptacles, and Connectors for Communication Systems

19. CAN/CSA T52893(R1997) (ANSI/EIA/TIA 606) - Design Guidelines for Administration of Telecommunications Infrastructure in Commercial Buildings

20. CISC Crane-Supporting Steel Structures: Design Guide (4th Edition 2021)

21. Access Design Guide

22. City's *Sustainable Building Policy* (C532)

23. City of Edmonton Design and Construction Standards (Volumes 1 to 8). Available on the City's website.

24. City of Edmonton Commissioning Consultant Manual – Volume 1 Whole Building Commissioning Process and Guidelines, 2018-11-30 and Volume 2 Building Envelope Commissioning Process and Guidelines, 2019-03-22. Available on the City's website.

25. City of Edmonton Facility Design & Construction Consultant Manual – Volume 1 Design Process Guidelines, 2022-11-21 and Volume 2 Technical Guidelines, 2021-09-10. Available on the City's website.

26. City's Gender Based Analysis +, and the City's "The Process of Inclusion: GBA+" tool and GBA+ reporting Template. Available on the City's website.

27. HFDG

28. City's *Accessibility for People with Disabilities Policy* (C602)

29. City's Solar Photovoltaic Program, Version 2.0. Available on the City's website.

30. City of Edmonton Visual Identity Standards, September 2022, available on the City's website; ETS Graphic Standards Manual: LRT Signage, Light Rail Transit, available as Disclosed Data

31. CSA C22.1 Canadian Electrical Code, Part I (Latest Adopted Edition), Safety Standard for - Grounding and Bonding Equipment

32. CSA T52794 (ANSI/EIA/TIA 607), Grounding and Bonding for Telecommunications in Commercial Buildings

33. CSA T52995 (ANSI/EIA/TIA 568D), Design Guidelines for Telecommunications Wiring Systems in Commercial Buildings

34. City's *Design Committee Bylaw,* 19784

35. City's *Zoning Bylaw*, 12800

36. FHWA-NHI-10-025 - Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes

37. IEC 62128-2 - Railway applications - Fixed installations - Electrical safety and the return circuit - Part 1: Provisions against the effects of stray currents caused by dc traction systems

38. NACE SP0169 - Standard Practice, Control of external corrosion on underground or submerged metallic piping systems

39. NBCAE 2023 - unless otherwise specified in this Schedule

40. NFPA 130 - Standard for Fixed Guideway Transit and Passenger Rail System (NFPA 130)

41. TAC Manual of Uniform Traffic Control Devices for Canada

42. TCRP Report 155 - Track design handbook for Light Rail Transit LRT

43. National Energy Code of Canada for Buildings

44. CAN/ULC-S524:2019 - Standard for Installation of Fire Alarm Systems

45. CAN/ULC-S536:2019 - Fire Alarm Annual Inspection Test

46. City's *Drainage Bylaw*, 18093

B. In addition to Section 7-2.2.A [*Applicable Codes, Reference Standards and Guidelines*], the structural engineering and design must comply with the requirements of applicable structural codes and standards, including but not limited to the following:

1. Canadian Foundation Engineering Manual (4th Edition, 2006)

2. ASTM A36/A36M - 2019 - Standard Specification for Carbon Structural Steel

3. ASTM A53/A53M - 2022 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

4. ASTM A123/A123M-17 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

5. ASTM A193/A193M-20 - Standard Specification for Alloy Steel and Stainless-Steel Bolting Materials for High Temperature or High-Pressure Service and Other Special Purpose Applications

6. ASTM A307 - 2021 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength

7. ASTM F3125/F3125M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric)

8. ASTM F1554 ae1-2017 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength

9. CSA S16:19 - Design of Steel Structures

10. CISC Crane-Supporting Steel Structures: Design Guide (4th Edition, 2021)

11. CSA A23.1:19 - Concrete Materials and Methods of Concrete Construction Structures

12. CSA A23.2:19 - Test Methods and Standard Practices for Concrete

13. CSA A23.3:19 - Design of Concrete Structures

14. CSA S136-16 (R2021) - North American Specification for the Design of Cold Formed Steel Structural Members Design of Cold Formed Steel Structural Members

15. CSA G30.5M - Welded Steel Wire Fabric for Concrete Reinforcement

16. CSA G30.15M - Welded Deformed Steel Wire for concrete reinforcement

17. CAN/CSA G30.18:21 – Carbon Steel Bars for Concrete Reinforcement

18. CSA S304-14 (R2019) - Design of Masonry Structures

19. CSA W59-18 - Welded Steel Construction

20. CSA G40.20/G40.21 - 2018 - General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel

21. CSA-G164-18 - Hot Dip Galvanizing of Irregularly Shaped Articles

22. The Canadian General Standards Board, CAN/CGSB 1.81-M90 - Ready-Mixed Organic Zinc-Rich Coating

23. CSA W47.1:19 - Certification of Companies for Fusion Welding of Steel

24. CSA W48:23 - Filler Metals and Allied Materials for Metal Arc Welding

25. CSA W55.3-08 (R2018) - Certification of Companies for Resistance Welding of Steel and Aluminum

26. CSA W59-18 - Welded Steel Construction (Metal Arc Welding)

27. CSA Z259.16:21- Design of Active Fall Protection System

28. S304.-14 (R2019) - Design of Masonry Structures

29. CSA S478:19 - Guideline on Durability in Buildings

30. CAN/CSA Z91-17 (R2022) - Health and Safety Code for Suspended Equipment Operation

31. Local Building Bylaws

32. CSA Z271:20 - Safety Code for Suspended Access Equipment

C. In addition to Section 7-2.2.A [*Applicable Codes, Reference Standards and Guidelines*], the Design must comply with the requirements of applicable mechanical codes and standards, including but not limited to the following:

1. National Plumbing Code of Canada

2. National Energy Code for Buildings

3. American Conference of Governmental Industrial Hygienists (ACGIH) – Industrial Ventilation: A Manual of Recommended Practice for Design

4. American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME) B31.1, latest edition, Power Piping

5. ANSI/ASME B31.5, Refrigeration Piping and Heat Transfer Components

6. Canadian Standards Association (CSA) B51, Pressure Vessel and Pressure Piping Code

7. CSA B52 - Mechanical Refrigeration Code

8. CSA B64.10 - Selection and Installation of Backflow Preventers

9. CAN/CSA-B149.1 - Natural Gas and Propane Installation Code

10. Environmental Protection Agency (EPA) 625/R-92/016 - Radon Prevention in the Design and Construction of Schools and Other Large Buildings

11. National Fire Protection (NFPA) 10 - Potable Fire Extinguishers

12. NFPA 13 - Installation of Sprinkler Systems

13. NFPA 20 - Installation of Stationary Pumps for Fire Protection

14. NFPA 30A - Code for Motor Fuel Dispensing Facilities and Repair Garages

15. NFPA 90A - Installation of Air Conditioning and Ventilation Systems

16. NFPA 2001 - Standard on Clean Agent Fire Extinguishing Systems

17. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Fundamentals Handbook

18. ASHRAE HVAC Applications Handbook

19. ASHRAE HVAC Systems and Equipment Handbook

20. ASHRAE Standard 55 - Thermal Environmental Conditions for Human Occupancy

21. ASHRAE Standard 62.1 - Ventilation for Acceptable Indoor Air Quality

22. ASHRAE Standard 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings

23. ASHRAE Standard 129 - Measuring Air Change Effectiveness

24. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) Duct Construction Standards – Metal and Flexible

25. Master Painters Institute Manual

26. Regulations of local inspection Authorities Having Jurisdiction

7-2.3 SUSTAINABLE BUILDINGS AND INFRASTRUCTURE RATING SYSTEMS

A. The Design and Construction of Llew Lawrence OMF must comply with City's *Sustainable Buildings Policy* (C532), including the requirements to:

1. achieve LEED® Silver Certification using LEED® Building Design and Construction: New Construction in accordance with Section 4-4 [*LEED Silver Certification for Llew Lawrence OMF*] of Schedule 4 [*Design and Construction Protocols*];

2. achieve 40% or greater energy efficiency than required by the NECB 2011 for the Llew Lawrence OMF;

3. benefits from any renewable and or alternative energy systems must not be considered as part of the energy modelling analysis;

4. achieve a Thermal Energy Demand Intensity (TEDI) that is less than or equal to 80 kWh/m2 for the Llew Lawrence OMF occupied areas.

B. The Design-Builder must provide, as a minimum, the required spaces for the future solar panel installation and termination. The Design must meet the City of Edmonton Solar Photovoltaic Program, Version 2.0, Design Guideline, COE-IM-GUIDE-0004. The main circuit breaker for the solar system

must be Designed at the supply side of one of the unit substations. Should the Design-Builder decide to incorporate solar panels in the design to meet the LEED Silver requirement, then the Design must meet City of Edmonton Solar Photovoltaic Program, Version 2.0, Design Guideline, COE-IM-GUIDE-0004.

C. The Design-Builder must support the City's submission for Building Owners and Managers Association (BOMA) Best certification upon occupancy through the provision of a report, bundling the required design and construction documentation as outlined by the BOMA Best program and which may be uniquely required for new construction projects to meet the requirements of the program. This may include an Energy Study Report, prepared during the Design of the building in lieu of a post-construction energy study report; and a Water-using Equipment Report. It may also include coordination with the commissioning authority for the Energy and Water Commissioning Plans. The Design-Builder must review the requirements of the BOMA Best Practices Guidelines and confirm specific deliverable requirements during the pre-Design stage with the City.

D. The Design-Builder is responsible for the building permit, including but not limited to, preparing documentation to support compliance to NECB 2020 (or the latest adopted code) for the Llew Lawrence OMF.

SECTION 7-3 – DESIGN GUIDANCE/REQUIREMENTS

7-3.1 REQUIREMENTS

A. The Design-Builder must Design and Construct Llew Lawrence OMF to be integrated with the existing Capital Line LRT to meet the requirements of Appendix 5-1B [*High Floor Operations and Maintenance Parameters*] of this Schedule.

B. The Design-Builder must Design the Llew Lawrence OMF to accommodate the number of operations, maintenance, transportation and support personnel in accordance with this Schedule.

C. To confirm the Design-Builder's understanding of the requirements of the DBA for the OMF, the Design-Builder is required within 90 days after the Effective Date, or at an alternate date accepted by the City, the Design-Builder must prepare and Submit a parametric programming report (the "**Llew Lawrence OMF Building Parametric Programming Report**") that describes the Design rationale, criteria, standards, and assumptions for the Design of the Llew Lawrence OMF, which must include a facility programming analysis, including assessment of the LRV storage and maintenance area and the support shop facility on the basis of:

1. allocation of functions listed in Section 7-3.2 [*Architectural*] and Section 7-3.3 [*Industrial*] of this Schedule;

2. analysis of individual spaces, including:

    a. space and building service requirements;

    b. access, including for cranes, delivery trucks and equipment as necessary;

    c. vertical and horizontal accessibility for building maintenance personnel and equipment;

    d. circulation to adjacent or related spaces;

    e. access control for safety and security;

    f. workplace health and safety equipment;

    g. clearances;

    h. HVAC requirements;

    i. lighting requirements: indoor and outdoor, also building exterior lighting;

    j. data requirements;

    k. security and A/V systems requirements;

    l. adjacency analysis to minimize unnecessary movement of personnel and handling of parts, tools, equipment and machinery;

    m. crane analysis, including the maximum lift that each crane will perform limits of reach, landing positions, sweep, and requirements for interlocking with catwalks, overhead line equipment, lifting jacks and any other cranes or equipment;

    n. equipment and machinery analysis, as set out in Section 7-3.3 [*Industrial*] of this Schedule, applying a RAM analysis process to specify reliability requirements for proposed tools and machinery, provided that:

i. where reliability data are not available for some tools they must be minimally specified as industrial grade and provided as such consistent with Good Industry Practice.

ii. provision of access to facilitate installation and change-out of fixed tooling, special tools, equipment and machinery without the need to perform modifications to the building structure.

o. program space analysis forms for each space in the Llew Lawrence OMF, with a separate form provided for each space which lists:

i. goals and objectives of the space;

ii. equipment, and machinery that will be housed in the space;

iii. furniture and storage required in the space;

iv. desired adjacencies to other functions;

v. special construction, building service and utility requirements that are to be provided;

vi. incorporating all Design requirements specified in this Section 7-3.1 [*Requirements*], and incorporating the prescriptive space requirements specified in Appendix 5-7A [*Llew Lawrence OMF Functional Program*];

vii. diagrammatic floor plan sketches, for each space in the Llew Lawrence OMF, with a separate scaled diagram for each space which depicts:

(a) the desired space configuration;

(b) Track numbers and LRV position identifiers as referenced in Part 7 [*Operations and Maintenance Facility*] and Appendix 5-7A [*Llew Lawrence OMF Functional Program*]; and

(c) the furniture, storage, equipment and utility services in the space.

p. modelling results depicting the overall circulation of maintenance personnel, equipment, machinery, and LRVs within Llew Lawrence OMF, access to all spaces within the Llew Lawrence OMF, and the LRV storage configuration;

q. overall scaled building layout drawings;

r. LEED® checklist, demonstrating compliance with Section 7-2.3 [*Sustainable Buildings and Infrastructure Rating Systems*] of this Schedule, and Section 4.4 [*LEED Silver Certification for Llew Lawrence OMF*] of Schedule 4 [*Design and Construction Protocols*];

s. tabulated equipment and machinery bill of materials;

t. confirmation of human factors considerations set out by the Work Systems Ergonomics Report requirements in accordance with Section 5.10 [*Human Factors Specialist*] of Schedule 4 [*Design and Construction Protocols*]; and

u. details of structural live loads used in the Design of the Llew Lawrence OMF, including, at a minimum:

i. Building floor plans showing locations, extents and magnitudes of all live loads due to use and occupancy;

ii. a modified train vertical live load model, if applicable, to use for the Design of the LRV storage area;

iii. a modified procedure to calculate dynamic load allowances for the train loads, if applicable;

iv. all applicable machinery and equipment load magnitudes, configurations, locations of application and corresponding impact factors, including, at a minimum, a forklift load model; and

v. all locations and magnitudes of concentrated loads resulting from maintenance and storage of LRV components.

3. the **Llew Lawrence OMF Building Parametric Programming Report** must include a phasing analysis of Ultimate Buildout impacts of Llew Lawrence OMF. The Design-Builder must provide report of cost, operational impact, and maintenance impact to Design and Construct Llew Lawrence OMF to optimize future alterations for Ultimate Buildout by others.

   a. Designs: Separate Design Data to the end of first Interim Design for Ultimate Buildout indicating development phasing required to Design and Construct Llew Lawrence OMF and Ultimate Buildout.

   b. Operations continuity: Minimize negative future construction impacts of Ultimate Buildout on productivity of Llew Lawrence OMF operations.

   c. Utilities: Provide utility capacity to accommodate future expansion of building mechanical, process, fire, electrical, ICTS services required for Ultimate Buildout.

   d. Building systems expansion: Provide shell space in Llew Lawrence OMF to accommodate expansion of building mechanical, process, fire, electrical, ICTS services required for Ultimate Buildout.

   e. Functional program expansion: Provide shell space in Llew Lawrence OMF to accommodate functional program elements in Ultimate Buildout requiring adjacency to functional program elements in Llew Lawrence OMF.

D. The **Llew Lawrence OMF Building Parametric Programming Report** may propose amalgamations of some of the support shop areas, ancillary shop areas spaces, and utility rooms described in Section 7-3.1 [*Requirements*] of this Schedule, however these must be accompanied by risk/benefit analyses and proposed mitigations. Such proposed amalgamations must not be implemented unless they are Accepted by the City pursuant to Schedule 2 [*Submittal Review Procedure*].

E. The Accepted **Llew Lawrence OMF Building Parametric Programming Report** must be used by the Design-Builder as the basis for completing the Design and Construction of the Llew Lawrence OMF.

7-3.2 ARCHITECTURAL

A. Site Context and SUI Project Requirements

1. The Design-Builder must Design and Construct the Llew Lawrence OMF in accordance with the requirements of the HFDG.

2. The Design-Builder must Design and Construct the Llew Lawrence OMF in alignment with CPTED principles per Section 2-4 [*Crime Prevention Through Environmental Design (CPTED)*] of this Schedule.

3. The Llew Lawrence OMF must be Designed and Constructed to be part of an integrated whole that includes consideration for the Ultimate Buildout of Llew Lawrence OMF.

4. The Design and Construction of the Llew Lawrence OMF must draw upon, complement, and enhance the architectural expression, character and identity of the existing Heritage Valley Transit Centre and the proposed Heritage Valley North Station.

5. The scale, massing, materials and other character-defining elements of the Llew Lawrence OMF, when applied and delineated appropriately in this context, must help to establish:

    a. an attractive, welcoming, and coordinated ensemble of civic architecture;

    b. a successful transit-oriented precinct where planned adjacent developments will support and be supported by the infrastructure;

    c. a coherent, safe, public realm.

6. The following are key Site context factors that the Design-Builder must consider in the Design and Construction of the Llew Lawrence OMF and adjacent public realm:

    a. the Llew Lawrence OMF is located east of the existing Heritage Valley Transit Centre, north of Ellerslie Road and east of Heritage Valley Trail SW on land having the following characteristics:

        i. predominantly undeveloped land;

        ii. adjacent to major Roadways;

        iii. street grid is mostly absent within adjacent developable parcels except for existing Roadways;

        iv. minimal bicycle and pedestrian connectivity to existing residential areas.

7. The Design-Builder must provide Barrier-Free access throughout the Llew Lawrence OMF, including but not limited to compliance with requirements of Section 7-2.2 [*Applicable Codes, Reference Standards and Guidelines*].

8. The Design and Construction of Llew Lawrence OMF, and all associated elements must:

    a. be minimally obstructive to clear on-track and on-roadway sight lines through and around the Llew Lawrence OMF and Site;

    b. incorporate architectural features that, visually and spatially, address and accommodate:

        i. the main personnel and public entry to the Llew Lawrence OMF

        ii. operations and delivery entry points to the Llew Lawrence OMF

    c. be in alignment with CPTED principles per Section 2-4 [*Crime Prevention Through Environmental Design (CPTED)*] of this Schedule;

    d. accommodate the safe and efficient removal of snow and the relocation and storage of snow on Site without negatively impacting the safety, enjoyment and accessibility of the Station and the surrounding public realm.

B. Character-Defining Architectural Elements

1. Character-defining architectural elements are those features or attributes of the Llew Lawrence OMF that, in fulfilling their primary functions, must:

   a. simultaneously address the main contextual and architectural opportunities and constraints of the Llew Lawrence OMF Site; and

   b. achieve good urban integration, locally, through a combination of scale, massing, geometry, materials, connectivity and accessibility.

2. Without limiting the Project Requirements set out in this and other Schedules, the Design and Construction of the Llew Lawrence OMF must incorporate all the character-defining architectural elements as stipulated in Part 7 [*Operations and Maintenance Facility*] of this Schedule.

3. The main character-defining architectural elements are:

   a. Site:

      i. a network of safe and convenient Barrier-Free pedestrian links, Roadway crossings, neighbourhood walkways, and SUPs;

      ii. pedestrian At-Grade crossings of Trackways; and

      iii. identically equipped and furnished sloped walkways or ramps and level landing areas that are fully coordinated and architecturally integrated with intersections, access points or other connecting elements that must safely guide Llew Lawrence OMF personnel and other facility users to and through the Llew Lawrence OMF Site.

   b. Llew Lawrence OMF facades:

      i. The Design-Builder must Design and Construct Llew Lawrence OMF facades that:

         (a) are of same construction type, claddings, colours and textures, openings, closures, on all building faces;

         (b) have claddings that are separated into not less than four approximately equal sized areas of distinct colour and cladding profile per structural bay separated by horizontal flashings and vertical reveal joints;

         (c) have a curtainwall opening in each third structural bay approximately one-half structural bay in width and height equal to a LRV bi-fold door, containing vision glass, glazed exit door and full width glass canopy except for the wall demising the warehouse from the future light maintenance building, per the Ultimate Buildout.

   c. Llew Lawrence OMF main entry:

      i. The Design-Builder must Design and Construct the Llew Lawrence OMF main entry to:

         (a) be visually clearly identifiable by Llew Lawrence OMF personnel and the public entering the Llew Lawrence OMF Site;

         (b) communicate the corporate identity of ETS and the City;

         (c) provide shelter to building occupants approaching the main entry by means of a building canopy or building overhang with soffit;

(d) be visually transparent accommodating visual surveillance of the main entry and immediate surroundings by building occupants.

d. Rooftop mechanical service rooms

i. The Design-Builder must Design and Construct rooftop mechanical service rooms:

(a) as architectural features of same construction type as building facades;

(b) with claddings, colours and textures that contrast with building facades;

(c) to be serviced by a freight elevator.

C. Building Code Compliance Summary

1. The Design-Builder must complete a building code analysis for the Llew Lawrence OMF in compliance with current codes and standards indicated in Section 7-2 [*Reference Documents*].

2. The Llew Lawrence OMF must substantially comply with the following Building Code Compliance Summary for the Ultimate Buildout of Llew Lawrence OMF.

Ultimate Buildout Building Code Compliance Summary		
Item	**Requirement**	**Comments**
Authority Having Jurisdiction	City of Edmonton	
Applicable Building Code	National Building Code of Canada – Alberta Edition	
Major Occupancy(s)	Group F Division 2 (medium hazard industrial) Group D (office)	Division B Attachment A
Building Area m^2	Ultimate Buildout 14,442 m^2	
Number of Storeys	3	
Basement Level	1	
Mezzanine Level	0	
Height of Building m	16 m	
Number of Streets	1	
Building Classification	Group F Division 2: Any Height, Any Area, Sprinklered	Minor Group D occupancy
Sprinkler System	Required	
Standpipe & Hose	Required	
Fire Alarm System	Required	Single or two stage system
Voice Communication	Yes	Public Address system
Emergency Power	Yes	
Special Systems	Yes	Welding, wash bay
Permitted Construction	Non-combustible	
Roof Construction	Non-combustible	
Occupant Load (per person)	Office (9.3 m^2) Manufacturing/Processing (4.6 m^2)	

Ultimate Buildout Building Code Compliance Summary		
Item	**Requirement**	**Comments**
	Storage Spaces Warehouse (28.0 m^2) Storage Spaces Garage (46.0 m^2)	
Barrier-Free Design	Yes	Level 1 and 2 floor areas must be barrier-free access. Level 3 is mechanical service room only – barrier-free access not required.
Occupancy Separation	None	

3. The Llew Lawrence OMF Reference Design for Ultimate Buildout was completed with the following building code analysis. The Design-Builder must perform their own Building Code analysis:

Llew Lawrence OMF Code Analysis	
General	Buildings fully sprinklered
location	Ellerslie Road west of 127 Street SW, Edmonton
building Height	3 storeys
Building Area	Ultimate Buildout 14,442 m^2
Major Occupancies	Office – Group D
	Storage – Group F2
Number of Streets	1 street – firefighter access route
Program Occupant Load	123 persons
3.1 General	
3.1.5	Non-combustible Construction
3.1.5.2 Minor Combustible Components	Minor combustible components are allowed in non-combustible construction. (3.1.5.2(1h)). *Applies to fibreglass thermal spacers such as a "Cascadia Clip".*
3.1.5.3 Combustible Roofing Materials	combustible cant strips and wood nailer facing to parapets (up to 600 mm high) are permitted in non-combustible construction. Wood nailer to be protected with sheet metal.
3.1.5.4 Combustible Glazing & Skylights	Combustible sashes and frames are allowed in non-combustible construction provided they are separated from other windows by non-combustible wall cladding. Windows in contiguous storeys should be separated by a minimum of 1 m and the aggregate total of the openings should total less than 40% of the wall face. (Applies to use of fibreglass frames in a non-combustible building. Note some manufacturers (but not all) of fibreglass windows are now considered to be non-combustible.)
3.1.5.10 Combustible Interior Finishes	Combustible interior finishes (paint, wallpaper, etc.) allowed if not more than 1 mm thick.
	Combustible interior wall finishes (other than formed plastics) allowed if not more than 25 mm thick and have a flame spread rating of not more than 150 on any exposed surface.
	Combustible ceiling finishes other than formed plastics, are permitted as long as flame spread rating not more than 25 or if fire-retardant-treated

Llew Lawrence OMF Code Analysis		
	wood except that not more than 10% of ceiling area in any fire compartment is permitted to have a flow-spread rating not more than 150.	
3.1.5.12 Combustible Insulation	This clause provides direction and restrictions on the use of foamed plastic and combustible insulation. Refer to clause.	
3.1.5.16 Combustible Piping	Combustible piping is allowed in non-combustible construction having a flame spread rating of 25 if not located in a slab or wall.	
	Combustible sprinkler piping is allowed.	
3.1.8 Fire Separations & Closures		
Table 3.1.8.4 Rating of Closures in Fire Separations	Fire Separations (FS) 45 min or 1 h 1.5 h 2 h	Rating of Closure (FRR) 45 min 1 h 90 min
3.1.8.6 Maximum Openings in Fire Separations:	Sprinklered – area: 22 m^2 with no dimension greater than 6 m	
	Fire Damper Waived (3.1.8.8)	
	Duct penetrating vertical fire separation of 0 h FRR (smoke separation) does not require a damper.	
	Non-combustible duct penetrating horizontal fire separation of 0 h does not require a damper. 20 min. Closures: 20 min. door allowed as closure in FS of 45 min. (3.1.8.10.(1b)) and/or with 1 h. FS located between a “public corridor” and “suite” or corridor and sleeping rooms. (“Public Corridor” provides an access to exit from more than one suite). Every door in a FS to be equipped with a self-closure. Hold Open Devices (3.1.8.12): Allowed. Device must be Designed to release as noted in clauses 3.18.12(2 or 3).	
	Door Latches (3.1.8.13): Swing-type door in a FS must positively latch	
3.1.10 Fire Walls	Fire walls in buildings containing a F2 use are to be 4 h and of masonry or concrete non-combustible construction. (3.1.10.2) Firewall to extend through roof to form a parapet 900 mm above adjacent roof. (3.1.10.4)	
3.1.11 Fire Blocks	Fire blocks must be placed at every floor level and that the maximum vertical dimension is not more than 3 m. Fire blocks not required if void is filled with insulation or if it is non-combustible construction. Crawl spaces or horizontal concealed spaces to have fire blocks restricting areas to 600 m^2 with no dimension greater than 60 m if FSR less than 25.	
3.1.13 Interior Finish	Flame Spread Ratings (FSR) (Table 3.1.13.2) Sprinklered occupancies - 150 maximum (FSR) Exits 25 maximum (FSR) Lobbies with exits passing through - 25 maximum (FSR) Elevator cabs 75 maximum (FSR)	
3.2 Size & Occupancy		
3.2.1 General	Service space not considered a storey (3.2.1.1(1))	
3.2.2 Building Size & Occupancy	Multiple Major Occupancy – Where multiple occupancies exist within a building the most restrictive requirements will apply. Storage Garage includes both storage (F3) and repair (F2) (light maintenance). Therefore, F2 applies. (3.2.2.6)	

Llew Lawrence OMF Code Analysis	
	Streets: For access roads to be considered streets must meet Clause 3.2.5.4 and .5. The access road must be located between 3 m and 15 m of the building perimeter (3.2.2.10). (Parking/access provided is within 15 m of Future Operations Control Centre on north side. No access on others. Future Operations Control Centre faces one street.) (Parking/access at east side of Storage is 15 m+/- but separated by rail line, ~15% of Storage perimeter. Storage not considered facing street as street access is ~15%.) Exterior Balconies – To be constructed similar to requirements under size and occupancy. Rooftop Enclosures: - Serving service rooms or stairs that are not more than a storey high are not required to have an FRR. (3.2.2.14) Sprinkler in Lieu of Roofing Rating: FRR waived if building sprinklered and it is supervised with signal to fire department (3.2.2.18) Size & Occupancy: Future Operations Control Centre - Group D, up to two storeys, sprinklered (3.2.2.63): Area of not more than 2,400 m^2 if two storeys; Combustible or non-combustible construction; Building fully sprinklered; Floor assemblies – FS, and 45 min if combustible (unrated if non-combustible but a “smoke” separation); Load bearing assemblies to be non-combustible or 45 min FRR. Storage - Group F2, Any Height, Any Area, sprinklered (3.2.2.74): Non combustible construction; Building fully sprinklered; Floor assemblies – 2 h fire separation; Mezzanines – 1 h fire separation Load bearing assemblies to be non-combustible and of same rating as structure carried/supported. This clause allows the Future Operations Control Centre to be of combustible construction. Items such as fibreglass windows, etc. are allowed without any restrictions. Storage is non-combustible. Note if considered as one building the second floor of the Future Operations Control Centre would need to be a 2 h FRR FS with a 1.5 h FS between Storage and the Future Operations Control Centre.
3.2.3 Spatial Separation and Exposure Protection	Llew Lawrence OMF Design must have regard for spatial separation at Future Operations Control Centre
3.2.4 Fire Alarm and Detector Systems	Fire Alarm required (3.2.4.1(1)) Alarm to be single or 2-stage (3.2.4.3(1d) 2-stage alarm to notify fire department on alert (3.2.4.7(3)). Annunciation: To be located close to building entrance (3.2.4.9) Fire Detectors: Need not be provided in a fully sprinklered building. (3.2.4.11 (3)) Smoke Detector: Required in exit stair shafts, elevator machine rooms and at draft stops (3.2.4.11).
3.2.5 Provisions for Fire Fighting	Access Routes: Required to building face (principal entrance), building is more than 600 m^2 in area (3.2.5.4). Access route must be located and Designed in accordance with 3.2.5.5 & .6. Standpipe: required, Table 3.2.5.8, building greater than 2000 m^2. Fire Department Connections: Hydrant to be located within 45 m of

<table>
<tr><th colspan="2">Llew Lawrence OMF Code Analysis</th></tr>
<tr><td></td><td>sprinkler connection (3.2.5.15(2)). FD connection to be no closer than 3 m and no more than 15 m from principal entrance.</td></tr>
<tr><td>3.2.7 Lighting & Emergency Power</td><td>Emergency power for lighting: 30 min. supply (3.2.7.4 (1b).
Emergency power:
30 min. to fire alarm (with 24 hr. supervisory power) (3.2.7.8).</td></tr>
<tr><td colspan="2">3.3 Safety within Floor Areas</td></tr>
<tr><td>3.3.1 Requirement Applying to All Floor Areas</td><td>Suites: Suites to be divided from other occupancies by a 45 hr. FS. (Note: As Llew Lawrence OMF is a single tenancy the term “suite” would not normally apply).
Rooftop Enclosures (Mechanical Penthouse): Mechanical Penthouse if over 200 m^2, or travel distance more than 25 m must have two means of egress (Clause 3.3.1.3(6)). (Mechanical penthouse is 3,280 m^2 therefore minimum two means of egress required. Second egress can be over roof.)
Egress Doorways (3.3.1.5):
Two doors required if the room or suites is over 300 m^2 (Group D).
Dead End Corridors: Unless located wholly within a suite, dead end corridors cannot exceed 6 m. (3.3.1.9(7)).
Doors and Hardware: (3.3.1.13)
Door in access to exit must be operable without use of keys.
Electronically operated locking device must operate on emergency power or capable of manual release by security personnel.
Electromagnetic locks on exit door may have a time delay not more than 30 seconds (see 3.4.6.16 (4).
Janitor Rooms: If sprinklered, fire separation may have a 0 h FRR (3.3.1.21(3)).
Repair Garage: 2 h fire separation from remaining occupancy (3.3.5.5)
Storage Garage: 1-1/2 h fire separation from remaining occupancy. (3.3.5.6).</td></tr>
<tr><td>3.4 Exits</td><td>Separation of Exits: Any one exit cannot provide more than 50% of exit capacity (3.4.1.2(2)).
3.4.2 Number & Location of Exits
Distance Between Exits: Maximum one half the maximum diagonal distance, but not less than 9 m Maximum Travel Distance.
Maximum Travel Distance: sprinklered – 45 m (3.4.2.5(1c)).
For Storage if exits are provided at 60 m spacing around the perimeter the travel distance requirements do not apply if cross aisles lead to the exits. (3.4.2.5(2). An alternative solution to building code compliance may be required.</td></tr>
<tr><td>3.4.3 Width & Height of Exits</td><td>Width (minimum):
1100 mm for corridors
1100 mm for stairs
800 mm for doors (3.4.3.2(8))
Exit Capacity: 8 mm/person for stairs, 6.1 mm/person for doors (3.4.3.2(2).
The following exits are required:
<table>
<tr><th>Floor Area</th><th>Type of Exit</th><th>Units of exit width (mm)</th><th>Occupant Load (persons)</th><th>Exit Width Required (mm)</th></tr>
<tr><td>future Operations Control Centre – Main Floor</td><td>doors</td><td>6.1</td><td>135</td><td>823.5</td></tr>
</table></td></tr>
</table>

Llew Lawrence OMF Code Analysis					
	future Operations Control Centre – Second Floor	stairs	8	135	1080
	storage – Main Floor	doors	6.1	50	305
3.4.4 Fire Separation of Exits	Rating of Exits: Per floor assembly, but not less than 45 min. (3.4.4.1(1). Service Room: Not permitted to open directly onto an exit (3.4.4.4(7)).				
3.4.5 Exit Signs	required per 3.4.5.1.				
3.4.6 Types of Exit Facility	Landings: Maximum rise between landings is 3.7 m. Landings to be at least length and width of stair width but in straight run does not need to exceed 1,100 mm (3.4.6.3). Handrails: Required on both sides if stair 1100 mm or wider. Handrail on at least one side of stair to extend 300 mm beyond top and bottom of stair (3.4.6.4). Guards: - 920 mm from edge of nosing and 1070 mm at landing. (3.4.6.6) Doors: Provide minimum 300 mm from face of riser to leading edge of door (3.4.6.11). Door Release Hardware: electromagnetic locks allowed if: door releases upon actuation of fire alarm; locking devices releases on loss of power; locking device release on actuation of manually operated switch accessible to authorized personnel; force of 90 N applied to opening hardware releasing door with 15 seconds (and not relock until door has opened); upon release locking device must be reset manually; door to be signed (3.4.6.15.(4)).				
3.5 Vertical Transportation	Fire separation to be 45 min (Table 3.5.3.1) Car dimensions of one car to allow access for a 2010 mm x 610 mm stretcher. (3.5.4.1) (1134 kg elevator sized 2032 mm x 1295 mm with a 915 mm opening on the short side or 1067 mm on the long side meets this criterion. (A 3.5.4.1(1))				
3.6 Service Facilities					
3.6.2 Service Rooms	Fire Separation: Fuel fired appliances in rooms require a minimum 1 h fire separation (building over 400 m^2. (3.6.2.1(1)). Electrical rooms to have 1 h fire separation (3.6.2.1(6)). Rooftop appliances do not require a fire separation to the building it serves (3.6.2.1(10)). Combustible refuse storage rooms (recycle room) to have 1 h fire separation. (3.6.2.5)				
3.6.3 Vertical Service Spaces (Shafts)	45 min fire separation				
3.6.4 Rooftop Access	Building to have direct access to the roof where HVAC equipment is on the roof and floor is not less than 4 m above grade (3.6.4.7(1). *(Standard 14-BCV-007 allows use of a ladder and/or non-conforming stair for access).*				
3.7 Health Requirements					
3.7.2 Plumbing Facilities	Waterless urinals permitted (3.7.2.1(2)) All washrooms unless noted otherwise are unisex, and the majority are Designed to be Barrier-Free. Water closet requirements calculated in accordance with Table 3.7.2.2B.				

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	(Based on occupant load of 90 persons (45 male/45 female) four WCs are required.) Permissible to substitute urinals for 2/3 of water closets (3.7. 2.2(5)). (Recommend in washrooms with four WC required that three WC and one urinal be used. All in toilet stalls.) Require one lavatory for every two water closets (3.7.2.3.1). Washroom Count –In Storage/Maintenance, assuming 50 two/sex required (T3.7.2.2.-C). Recommend 3/sex.
3.8 Barrier-Free	
3.8.2 Application	Entrance: Required to be Barrier-Free (3.8.2.2(1)), 50% of the entrances to also be Barrier-Free. Path of Travel: Requires unobstructed width of at least 920 mm (3.8.2.3(1)). 3.8.2 Application Barrier-Free access to be provided to all normally occupied floors (3.8.2.3(1)). Handicap Parking: Table 3.8.2.8 (Based on 130 parking stalls, four to be provided in order to meet the Barrier-Free requirements.) Washrooms: To be Barrier-Free (3.8.2.3(1)). Where more than one WC required, provide one WC per 10 stalls. (Note: Washrooms Designed as Barrier-Free where practicable).
3.8.3 Design	Note: Refer to this section for detailed Design requirements. See specifically: Clause 3.8.3.8(2) grab bars. Clause 3.8.3.10 requires urinals in a barrier-free washroom to have vertically mounted grab bar on both sides. Clause 3.8.3.12 “Universal Toilet Rooms”.
Part 5 Environmental Separation	Radon – Required to minimize impact. (5.4.1.1.(e)) National Energy Code for Buildings 2017 (NECB 2017)

D. Public Health and Safety

1. The Design-Builder must provide a minimum of one permanently affixed hand sanitizer station at each building entrance.

E. Lockers/Washrooms

1. The Design-Builder must provide:

   a. floor to ceiling partitions (on 100 mm base to allow drainage)

   b. clear locking/occupancy signage

   c. natural surveillance

   d. no perimeter doors/hidden areas

   e. multiple points of entry/exit

   f. grooming privacy area (tooth brushing, makeup)

   g. ambient background noise for audible privacy

   h. help call button

i. signage per Access Design Guide (toilet - not male/female figures)

j. lockers:

i. one full-height locker per Appendix 5-7F

ii. two full-height lockers per Appendix 5-7F

iii. locker size – 457W x 457D x 1830H

F. Shop Tracks

1. The Design-Builder must:

a. provide a sufficient number of individual bays to accommodate the LRV fleet as required to meet Appendix 5-1B [*High Floor Operations and Maintenance Parameters*], including:

i. Wash Bay

(a) one automated drive-through wash bay providing operating functionality for a 5-car LRV train, on Track W2, Track Positions LRV EW-4 and LRV EW-5

ii. LRV Interior Cleaning

(a) LRV interior cleaning area accommodating two trains of five coupled LRVs each with LRV access platforms on Tracks W1 and W2, Track Positions LRV IC-1 through LRV IC-10, including LRV train-exterior drip-dry after wash

iii. LRV Inspection/Exterior Wash

(a) The Design-Builder must provide the following areas to support the performance of safety inspections and corrective/preventive maintenance

(b) LRV Inspection/Exterior Wash area on Track W2 accommodating a 5-car coupled LRV train at Track Positions LRV INSP-1 through LRV INSP-5

iv. one LRV length of pit for undercarriage inspection and wash in accordance with Section 7-3.3 [*Industrial*] of this Schedule

(a) LRV roof-level gantry on both sides for roof inspection and wash at Track W2, Track Position LRV-INSP-5 in accordance with Section 7-3.3 [*Industrial*] of this Schedule with no physical access to the roof level

v. LRV Light Maintenance/Base Scope

(a) three regular maintenance tracks on Tracks R1, R2 and R3, accommodating two uncoupled LRVs each;

(b) two 2 tonne cranes on one roof supported crane runway with 2 tonnes capacity over Track R1;

(c) one 10 tonne roof supported crane runway with 10 tonnes capacity over Track R3;

(d) one track with pit and gantry at Track R1, Track Positions LRV R1-1 and LRV R1-2;

(e) one track equipped with three in-ground lifts accommodating one uncoupled LRV at Track R2, Track Position LRV R2-2;

(f) one set of four turn tables for bogie replacement operations, and one adjacent bogie lift repair table, at Track R2 and Track R3, Track Positions LRV R2-2 and LRV R3-2;

(g) The Design-Builder must provide a floor that will support a portable jack system capable of lifting the mass of an LRV plus 20%; and

(h) The Design-Builder must provide clearance to lift an LRV a minimum height of 2.0 m from floor level.

b. space Shop Tracks in accordance with Appendix 5-7A [*Llew Lawrence OMF Functional Program*] to accommodate the functions required of each bay, accounting for any activity and machinery required to perform the prescribed tasks;

c. provide maintenance bays and storage tracks with length to accommodate:

i. Maintenance bay track length: Design-Builder must Design and Construct maintenance bays of two uncoupled LRV units in length with not less than 2500 mm clear space between couplers, plus 8000 mm clear space at ends of bays, where maximum usable length of a track is defined by clearance points calculated based on track spacing and supplied LRV clearance envelopes.

ii. LRV Storage track length: Design-Builder must Design and Construct storage bays of track length equal to two trains each having five coupled LRV units, plus 6000 mm clear space at ends of bays and between trains.

d. have all Shop Tracks located on horizontal tangents;

e. have all maintenance bays and storage tracks located at the same elevation. Slope concrete floor to facilitate drainage to catch basins within building;

f. have all maintenance bays and storage track elevations match adjacent floor elevations;

g. provide sufficient space between adjacent maintenance bays and storage tracks on the same track to allow passage of personnel and maintenance equipment between parked LRVs;

h. provide sufficient space between the panel folding doors, when open, and the ends of parked LRVs to permit safe passage of personnel, cleaning equipment, and maintenance equipment;

i. provide clearances to permit LRVs to enter and exit maintenance bays and storage tracks without being trapped by LRVs in adjacent bays;

j. have a vertical profile that limits the risk of runaway LRVs from maintenance bays and storage tracks;

k. provide OCS for all tracks, including Track S6 which shall not be energized for diesel equipment storage;

l. clearly identify the extents of the worst-case LRV track clearance envelope along the full length of all Shop Tracks by, for example, providing paint markings on the floor;

m. provide a minimum of one Emergency Alarm Station per maintenance bay located mid-track; and

n. provide Embedded Track for the full length of each Shop Track, unless otherwise specified as Pit Track.

G. LRV Storage and Maintenance Areas

1. This Section 7-3.2.G [*LRV Storage and Maintenance Area*] sets out the general requirements for LRV storage and maintenance areas within the Llew Lawrence OMF.

2. The Design-Builder must provide automated panel folding doors for LRV entry and exit at the Llew Lawrence OMF as follows:

    a. LRV doors are to be a pair of folding bi-fold doors;

    b. if the door movement envelope infringes on a safe walking route, a pedestrian door must be integrated with bi-directional visibility to provide safe passage and avoid unnecessary opening and closing of the panel folding door;

    c. the controller for doors must be placed in a location that does not restrict vehicle or pedestrian movements and allows visibility such that the doors open and close safely without obstruction;

    d. when the doors are moving, there must be a visible and audible warning;

    e. the movement of pedestrians must not activate the panel folding doors; and

    f. doors must be provided with emergency power.

3. Exterior convenience doors: The Design-Builder must provide heavy duty exterior person doors with a panel allowing bi-directional visibility except as noted below.

4. Exterior exit-only doors: The Design-Builder must provide heavy duty exterior person doors without exterior hardware along the length of the storage area spaced a maximum of 45 m apart.

5. The Design-Builder must provide a minimum of two permanent fixed eye wash facility and one permanent fixed eye wash/shower station accessible to every maintenance track.

6. The Design-Builder must provide a minimum of one permanent fixed eye wash facility at every second storage track. Place the eye wash station between the trains of LRVs in the LRV storage area.

7. The Design-Builder must provide a floor within all LRV maintenance areas that will support a portable jack system capable of lifting the mass of an LRV plus 20%.

8. The Design-Builder must provide clearance to lift an LRV a minimum height of 2.0 m from floor level.

H. LRV Storage Area

1. The Design-Builder must provide LRV internal storage area to support overnight LRV storage.

2. The Design-Builder must Design and Construct the LRV internal storage area to berth:

    a. LRVs up to 25 m length, coupler to coupler, trains of five coupled LRVs approximately 125 m long, with space provided around the ends of single LRVs or trains for movement of staff and equipment;

    b. not less than 30 LRVs in 5 coupled LRV trains simultaneously on dedicated LRV-only (Tracks S7, S8, and S9, Track Positions LRV-1 through LRV-30);

    c. diesel-fueled right-of-way maintenance equipment equivalent in length to not less than two 5 car coupled LRV trains with space provided around ends of trains for movement of staff and equipment simultaneously on Track S6, Track Positions LRV-31 through LRV-40.

d. platform accessing every track:

i. access to door level on one side of the LRV

ii. centre to centre distance between parallel LRV storage tracks must not be less than 4500 mm

3. The LRV internal storage area must be rectangular in shape with all LRV storage track end points aligned.

I. Track Maintenance Workshop in Warehouse

1. This Section 7-3.2.I [*Track Maintenance Workshop in Warehouse*] sets out the general requirements for the support shop areas to be provided within the Llew Lawrence OMF.

2. The Design-Builder must provide a temporary workshop area within the warehouse for repair and servicing of LRV components. The temporary workshop is to remain in place until the Ultimate Buildout is completed. The area for the temporary workshop is included in the overall warehouse area. The workshop must include:

a. adequate space for up to three work benches with minimum work surface dimensions of 1200 mm x 2400 mm;

b. adequate space for up to three maintenance personnel to work at the same time;

c. the paint booth bench and blast cabinet identified in Appendix 5-7B [*Llew Lawrence OMF Equipment Requirements*] with all necessary power and air supply;

d. removeable partitions to delineate the workshop area from the balance of the warehouse; and

e. shelving for the storage of ROW maintenance related equipment and signs.

3. Workshop areas:

a. must each be designated for a separate support function;

b. may include separated enclosures as a result of human factor considerations set out by the Human Factors Report requirements in accordance with Section 5.10 [*Human Factors Specialist*] of Schedule 4 [*Design and Construction Protocols*];

c. must include access for forklift, electric cart, or delivery truck;

d. forklift access path must maintain a clear height of not less than 3.4 m;

e. must include access to loading dock for large volume deliveries and components shipping and receiving; and

f. must include lighting, heating, cooling, ventilation, drainage, and waste disposal in accordance with NBCAE and applicable standards.

4. All workshop functions must be located on ground level.

J. Warehouse

1. The Design-Builder must provide a warehouse to support the equipment and activities associated with loading, shipping, receiving, warranty recovery, parts issuing, and component storage.

2. The Design-Builder must Design and Construct the warehouse to include the following:

    a. Vehicle apron accommodating required vehicle specifications directly adjacent to warehouse

    b. loading dock with dock leveler, overhead door with dock seal/shelter, and truck ramp

    c. an at-grade overhead door accessing vehicle apron;

    d. provide door seals to overhead doors;

    e. double swing door accessing vehicle apron;

    f. accommodation of equipment to aid the lifting of heavy objects/deliveries such as counterbalanced lift truck;

    g. a parts issue counter;

    h. accommodation of an open workstation for inventory management processes;

    i. accommodation of five secure tool storage areas which are fenced and of size 3 m long x 3 m deep;

    j. pallet racking for medium to large sized product storage;

    k. heavy duty industrial shelving for small part storage.

3. The Design-Builder must Design and Construct the warehouse to provide:

    a. direct exterior vehicular access to the warehouse loading dock and At-Grade overhead door;

    b. direct interior access from the warehouse to the warehouse loading dock and At-Grade overhead door;

    c. ready access to LRV Light Maintenance.

4. The Warehouse must have a volume not less than that required to house the spare part equipment specified by Section 5.5.10 [*Spare Parts*] of Schedule 4 [*Design and Construction Protocols*].

K. Hazardous Material and Waste Oil Storage Room

1. The Design-Builder must provide a hazardous material and waste oil storage room to support the equipment and activities associated with the handling, control and storage of hazardous materials.

2. The Design-Builder must Design and Construct the hazardous material and waste oil storage room to include, and provide the following:

    a. accommodation of containment pallets;

    b. accommodation of inflammables material storage cabinets;

    c. a self-contained emergency shower and permanent fixed eye wash facilities with a drainage system;

    d. accommodation for the handling and storage of drums of waste fluids, motor oil, transmission fluids and coolant; and

e. provide spill containment for waste fluids, motor oil, transmission fluids and coolant.

3. All electrical apparatus in the hazardous material and waste oil storage room must be explosion proof and shall be compliant with sections 18 and 20 of the Canadian Electrical Code and bonded as per section 10 of the Canadian Electrical Code.

4. The Design-Builder must provide a hazardous material room and waste oil storage with an oil tank with a minimum capacity of 1500 litres and appropriate environmental protection. The preferred location for the waste oil storage tank is on the building exterior. A building interior location is permissible, however, if an interior location is selected then the Design-Builder must Design and Construct a tank connection through the building exterior face, along with additional piping, venting and spill containment.

L. Lubricant/Fluids Room

1. The Design-Builder must provide a lubricants/fluids room to support the equipment and activities associated with lubrication and oil handling and storage.

2. The Design-Builder must Design and Construct the lubricants/fluids room to include, and provide the following:

a. accommodation of containment pallets;

b. accommodation of inflammables material storage cabinets;

c. permanent fixed eye wash facilities with a drainage system;

d. accommodation for the handling and storage of oils, lubricants, compressor and auxiliary equipment, lubrication pumps, and storage vessel equipment:

i. Fluids in 55 USG drums to include:

(a) Windshield washer fluid

(b) grease

(c) synthetic gear lubricant (in a 1500 litre tank with spill containment)

(d) Univis HVI 26

e. all electrical apparatus in the lubricant and oil storage room must be explosion proof and shall be compliant with sections 18 and 20 of the Canadian Electrical Code and bonded as per section 10 of the Canadian Electrical Code.

3. The Design-Builder must Design and Construct the lubricants/fluids room to provide ready access from/to the regular maintenance/inspection area.

4. All electrical apparatus in the lubricant and oil storage room must be explosion proof.

M. Parts/Tools Room

1. The Design-Builder must provide a parts/tools room for the handling and storage of various tools and miscellaneous equipment.

2. The Design-Builder must Design and Construct the parts/tools room to include, and provide the following:

a. accommodation of containment pallets; and

b. accommodation of inflammables material storage cabinets.

3. The parts/tools room must be a secure room.

N. Other Support Shop Areas

1. The Design-Builder must provide a loading dock with dock lever for large volume deliveries and components shipping and receiving, covered and protected from weather elements.

a. Provide a freight elevator in the loading dock with direct access to other levels of the facility, with a minimum capacity of 9000 kg.

2. The Design-Builder must provide an area for handling waste and recycling materials.

3. The Design-Builder must provide a dedicated first aid room.

4. The Design-Builder must provide a safe walkway which must be:

a. an area designated as non-PPE (personal protective equipment) to allow employee access from the main entrance of the building to the main floor ancillary areas, including the washrooms, employee lockers, dispatch space, driver reporting area/lunchroom, and the LRV storage area; and

b. walled off from open work areas where hazards exist that would warrant the use of PPE.

O. Ancillary Areas

1. This Section 7-3.2.O [*Ancillary Areas*] sets out the general requirements for ancillary areas to be provided within the Llew Lawrence OMF. These areas account for administrative, operations and support functions other than direct maintenance. Each required area must be sized and configured in accordance with Good Industry Practice.

2. Ancillary areas must be on separate electrical circuits from areas specified in Section 7-3.2.G [*LRV Storage and Maintenance Area*] and Section 7-3.2.I [*Track Maintenance Workshop in Warehouse*] of this Schedule.

3. At LRV Interior Cleaning, the Design-Builder must provide a central vacuum system that services the LRV cleaning lanes with one outlet per LRV position, total 10 outlets each with hose reel.

4. The Design-Builder must provide a passenger elevator to service all office spaces, administration spaces, and employee welfare and wellness spaces that are not located on the ground level.

P. Office Spaces

1. The Design-Builder must provide office spaces to meet Appendix 5-7A [*Llew Lawrence OMF Functional Program*].

2. The City will supply and install all furniture and furniture systems after Construction Completion. The Design-Builder must work with the City to determine all furniture and furniture systems requirements, including quantities and layouts, during Design.

Q. Administration Spaces

1. The Design-Builder must provide administration spaces to meet Appendix 5-7A [*Llew Lawrence OMF Functional Program*].

2. The City will supply and install all furniture and furniture systems after Construction Completion. The Design-Builder must work with the City to determine all furniture and furniture systems requirements, including quantities and layouts, during Design.

R. Employee Welfare and Wellness Spaces

1. The Design-Builder must provide employee welfare and wellness spaces to meet Appendix 5-7A [*Llew Lawrence OMF Functional Program*].

    a. green space/outdoor seating area, as may be beneficial for purposes of LEED calculations as set out in Section 7-2.3 [*Sustainable Buildings and Infrastructure Rating Systems*] of this Schedule.

2. The City will supply and install all furniture and furniture systems after Construction Completion. The Design-Builder must work with the City to determine all furniture and furniture systems requirements, including quantities and layouts, during Design.

S. Janitor Room

1. The Design-Builder must provide a janitor room on each level to support activities associated with cleanliness and hygiene of the ancillary and support areas of the Llew Lawrence OMF.

T. Service Rooms

1. The Design-Builder must provide service rooms which support operations of the facility, for which the associated equipment, components, materials, systems, and sub-systems and their distribution must be Designed in accordance with Section 7-1 [*Description of Infrastructure*] of this Schedule and the City of Edmonton Design and Construction Standards.

2. The Design-Builder must Design and Construct one or more separate service rooms for each building system including but not limited to the following:

    a. TPSS Rooms

        i. The Design-Builder must provide a TPSS located in the Llew Lawrence OMF Utility Complex as described in Section 7-3.14 [*TPSS*] of this Schedule.

    b. Mechanical Rooms

        i. The Design-Builder must provide a mechanical room(s) to house, and provide the equipment required for, the building mechanical systems. This includes equipment such as central heating equipment, central cooling equipment, hydronic distribution equipment, and domestic water heating equipment and air compressor.

    c. Electrical and Solar Equipment Rooms

        i. The Design-Builder must provide an electrical room(s) to house, and provide all equipment required for, the building electrical system and provision for solar system equipment.

        ii. This includes equipment such as the main electrical distribution gear, central distribution panels, transfer switches, inverters, motor control centers and solar power converters.

        iii. Supply equipment required for the building electrical system and solar system equipment must not be located in LRV maintenance bays.

    d. Sprinkler Room

i. The Design-Builder must provide a sprinkler room to house, and provide the equipment required for, a sprinkler tree connected to the main water service entrance, and additional equipment to distribute water to the sprinkler zones within the building.

e. Communications Rooms

i. The Design-Builder must provide communications rooms within the Llew Lawrence OMF Utility Complex as described in the Appendix 6E [*Communications Design Preliminary Report*] of Part 6.

ii. The Design-Builder must provide one MNAR and one NAR on each additional floor within the Llew Lawrence OMF as described in Section 7-3.7.2 [*Information, Communications Technology, Security (ICTS*I].

iii. The Design-Builder must Design and Construct the MNAR following the requirements given in the Construction Consultant Manual Volume 2 COE-IM-GUIDE-0002 Technical Guidelines v0 and/or in consultation with the Authority Having Jurisdiction.

U. Pedestrian-only non-public corridor

1. Design- Builder must design and construct a pedestrian-only non-public corridor which:

a. connects to the following functions:

i. Llew Lawrence OMF building exterior at on-grade walkway to Train Operator platforms;

ii. Llew Lawrence OMF administration and operations functions, at one common connection point for all;

iii. tracks having deep cleaning, Wash Bay and LRV inspection, at one common connection point for all;

iv. LRV storage; and

v. exterior exits required for the pedestrian-only non-public corridor;

b. accommodates future connection to the following functions in Ultimate Buildout:

i. light maintenance; and

ii. future Operations and Control Centre;

c. is interior space in a permanent building;

d. does not cross tracks within LRV dynamic envelope including OCS;

e. does not transit through building interior functions and spaces requiring PPE; and

f. is permitted to also function as an exit(s).

V. Stage 1 Base Scope Considerations

1. The Design-Builder must Design and Construct Llew Lawrence OMF:

a. in compliance with Appendix 5-7A [*Llew Lawrence OMF Functional Program*] Section 7-A.1.1.B [*Room Data*] for rooms having a number of instances greater than zero in the heading "Number Instances of Room";

b. having a two-storey administrative area with a forklift corridor with a minimum clear height of 3.4 m, connecting the warehouse to the interim maintenance area;

c. having a ROW storage facility outfitted for interim LRV light maintenance;

d. having no purpose-built LRV light maintenance bay;

e. having capacity for future facility, track and Site alterations to accommodate the LRV light maintenance program indicated in Ultimate Buildout.

7-3.3 INDUSTRIAL

A. This section sets out the Design and Construction requirements to allow performance of the maintenance activities at the Llew Lawrence OMF as listed below:

1. LRV exterior wash;
2. LRV interior cleaning;
3. LRV daily servicing;
4. LRV sand filling;
5. LRV undercarriage wash;
6. LRV roof wash;
7. LRV scheduled service and inspections;
8. LRV interior repair;
9. LRV vinyl wrapping;
10. LRV mechanical/electrical/electronic components overhaul and repair;
11. Small part painting with abrasive blasting;
12. LRV bogie replacement;
13. LRV windshield wash;
14. Movement of maintenance personnel, materials, and equipment between LRVs;
15. Storage areas for LRV components, parts and materials located in the warehouse with drive-through delivery access;
16. Storage of hazardous materials;
17. Industrial and household waste disposal;
18. Administrative support for LRV maintenance processes; and
19. Storage of diesel fuel.

B. Design-Builder must provide, install and commission, at a minimum, all equipment identified in Appendix 5-7B [*Llew Lawrence OMF Equipment Requirements*].

C. Site Requirements

1. Sand Silo

    a. The Design-Builder must provide a sand silo for the storage of sand to be used for LRV sand filling. The sand silo must:

        i. provide a sand silo to store at least 15 tonnes of sand;

        ii. comply with industry best practice for transit sand silos and receptacles;

        iii. be fillable from the exterior of the building with truck drive-through access, without backing up;

        iv. keep sand in a dry, uncontaminated condition;

        v. provide easy sand handling;

        vi. provide a low level annunciator to signal when 10 tonnes of sand are remaining;

        vii. provide economical refilling (filling stops when sandbox is full);

        viii. prevent sand spills;

        ix. prevent sand dust emissions (silicate); and

        x. be pneumatically fed to sand dispensing units along cleaning bays.

2. Diesel Fuel Storage Tank

    a. The Design-Builder must provide an above ground tank for the storage of diesel fuel to be used for ROW maintenance vehicles and yard equipment. The Design-Builder is responsible for the sizing and selection of all instruments, valves, pumps and any other equipment and accessories within the battery limits. The equipment supplied must have all the necessary components and controls to be able to operate safely and reliably. The control system configuration and programming must be performed in accordance with the functional requirements provided in the Agreement. All dispensers must be metered and must be a remote cabinet dispenser. At offloading/fill points, truck loading connections and fueling hoses/dispensers must be installed such that drips are captured in secondary containment. Tanks must be equipped with level monitoring and overfill protection integrated with the fuel delivery truck unloading equipment. The diesel fuel tank must:

        i. be 4000 L capacity;

        ii. be mounted on a concrete platform;

        iii. be refillable from the roadway/loading area;

        iv. be accessible to the track mounted ROW equipment for refueling; and

        v. be accessible to diesel fueled ROW road vehicles and OMF yard vehicles.

    b. Diesel fuel not included.

D. Pit and Gantry Requirements

1. Where required, the Design-Builder must provide below grade access to LRV undercarriage by means of below grade pits that:

a. are sized to accommodate two uncoupled LRVs over the pit, provide access to the end faces and allow for unobstructed access when opening side access hatches of the LRVs;

b. where applicable provide a unified pit combined between all tracks adjacent to each other in the LRV maintenance area;

c. include 1070 mm high guards to enclose the perimeter of the top of the pit while there is no LRV over the pit, which can be removed by a single person;

d. include access platforms and stairs at grade to allow for the safe passage of shop personnel and equipment over the pits at every LRV door location;

e. Platforms must be a solid surface and, at a minimum, the width of the LRV door;

f. include 1070 mm high guards along the side edges of the access platforms, which can be removed by a single person;

g. provide a pit refuge space to allow personnel to safely walk between the edge of the pit wall and running rail;

h. provide a minimum pit depth of 2100 mm from top of rail to pit floor;

i. provide emergency egress at each end of the pits and at a maximum of 40 m intervals;

j. include grated trench drains in the pits with removable covers that provide drainage to an oil-grit separator;

k. are constructed so that all mechanical/electrical pipes, conduits and conveyances are attached to the pit walls and do not encumber access within the pits;

l. elevated tracks (in-ground hoists) to accommodate one LRV that provide equivalent access to that provided by the below grade pits described in Section 7-3.3 [*Industrial*] of this Schedule, by application of an engineered solution that can be demonstrated to have been successfully used in a service proven high floor LRV operation and maintenance facility. There are three hoists located at the Track Position LRV R2-2 of track R2 shown in Appendix 5-7A. and

m. include electrical, compressed air, and grease/lube connections.

2. Where required, the Design-Builder must provide LRV roof level access from the sides of the LRV that accommodates:

   a. convenient and safe access to both sides of the LRV and to the end faces of the LRV at both LRV rooftop (3300 mm above main floor level), and LRV passenger entry level; the ability to open or remove LRV skirt covers and rooftop HVAC units.

3. Provide a work platform on each side of Track R1 at Track Position LRV R1-1 and LRV R1-2 at 3300 mm above main floor level.

4. Where required, provide roof level access to the top of the LRVs by means of platforms that:

   a. accommodate convenient access alongside two uncoupled LRVs to the roof;

   b. include electrical and compressed air connections;

   c. include removable guards at the edges of the gantry;

d. are located above the top of the LRV rail at a height that allows access to the roof of the LRV with a vertical gap not exceeding 80 mm;

e. have a minimum gantry width of 2.0 m on the outside of the outer most tracks. Gantries between tracks must fill the space between the LRVs and include openings for hoisting from pit level to gantry level;

f. are solid surfaces with toe board protection to prevent tools and materials from falling below; and

g. have a maximum horizontal gap not exceeding 80 mm from the edge of the platform to the closest point on the LRV at the gantry elevation.

E. In-Ground Lift Requirements

1. The Design-Builder must provide an area to support the performance of the following, at a minimum:

   a. LRV day-to-day repairs and inspections requiring lifting of the LRVs

2. Each in-ground lift must accommodate one uncoupled LRV.

3. The Design-Builder must provide in-ground lifts that will:

   a. have a minimum lift height of 2000 mm;

   b. have overall capacity of 66 tonnes and shall be capable of supporting bogies as well as body at each truck position; and

   c. be installed on Track R2.

4. The Design-Builder must provide four turntables which:

   a. must be placed in the same area as in-ground hoists (Tracks R2 and R3);

   b. each must have a minimum capacity of 10 tonnes;

   c. arrangement of turntables shall accommodate pass through of bogies to an adjacent track;

   d. provide a bogie lift table with a minimum capacity of 10 tonnes and shall be sized to bogie dimensions.

F. LRV Interior Cleaning

1. The Design-Builder must provide a deep cleaning area to support the activities associated with the thorough cleaning of the LRV floors, interior panels, ceilings, plastic seats, and windows.

2. The Design-Builder must Design and Construct the deep cleaning area to include:

   a. two service access levels:

      i. access to undercarriage via pit at 2100 mm below TOR;

      ii. access for LRV roof cleaning at both sides of one uncoupled LRV via platforms at 1980 mm above TOR;

      iii. Handwash rough sink on each deep cleaning track;

iv. Deep cleaning area floor sloped to drain with floor drains; and

v. Water hose and high pressure hot water connections on each deep cleaning track.

b. Pressure Washer

i. Single pump and heater unit supplying two wands, with positioning and hose length capable of reaching all areas in the wash bay.

ii. Minimum pressure of 2500 psi.

iii. Minimum flow of 4 GPM.

iv. Adjustable water temperature between 40 and 70 degrees Celsius.

v. Detergent injection system.

vi. Provide related accessories at each wand position: hose reel, wand, trigger gun, nozzles, hose hangers.

G. Wash Bay Equipment

1. The Design-Builder must provide an automated wash rack that includes:

a. areas to conveniently perform the wash as a planned, occasional function upon a train's arrival from revenue service;

b. functionality to be able to wash exterior sides of the LRV;

c. water heating and pressurizing equipment, pumps, drainage and wastewater treatment facilities, ventilation, and power and control equipment:

i. the supply of pressurized hot and cold water, compressed air and shop power at two levels;

ii. storage space for tools, accessories and material storage;

iii. an automatic wash rack with water nozzles and brushes that clean the ends, and sides of both vehicles in a two-LRV consist in less than 10 minutes;

iv. automatic mode operation, activated by the incoming train as it moves through the wash on its own power;

v. wash system override to permit a train to pass through the wash area without wash system activation;

vi. heating, cooling, and exhaust stacks for cleaning equipment;

vii. storage tanks and a filtration system to accommodate the washing of at least 12 five-LRV consists per day;

viii. speed of the wash rack must be adjustable for LRV speeds between 1 to 5 km/h; and

ix. splash wall must be provided to avoid water spray or spillage on adjacent work areas.

H. Overhead Crane Requirements:

1. Provide underrunning bridge cranes to accommodate tracks that are installed with LRV rooftop access gantry to support with overhead equipment repair and material handling activities. Minimum hook height to be 5385 mm above top of rail.

2. Provide two 2 tonne bridge cranes spanning from centre line of Track R1 to centre line of Track R2. Continuous crane rails suspended from the roof structure aligned with the centre line of Track R1 and the centre line of Track R2 are to have a 2 tonne capacity.

3. Provide one 10 tonne bridge crane spanning from centre line of Track R3 to the exterior wall. Provide continuous 10 tonne capacity crane rails suspended from the roof structure aligned with the centre line of Track R3 and along the exterior wall.

4. Crane layouts to be completed in accordance with Appendix 5-7E [*Crane Layout*] of this Schedule.

I. Stage 1 Considerations

1. All the pit, gantry, in-ground hoist, turn tables, exterior wash, and deep cleaning requirements must remain the same as the Ultimate Buildout.

2. Provide an under-running bridge crane runway with a 10 tonne capacity (to accommodate a future 10 tonne crane that will span all three tracks) in the ROW equipment storage area (interim maintenance area) along grid J.

7-3.4 STRUCTURAL

A. Structural Design Loads

1. Structural design loads must be determined based on the NBCAE, applicable codes and standards and Project Requirements. Design loads include building structure vertical dead, live, climatic and lateral loads, mechanical equipment, electrical equipment, ICTS equipment, industrial equipment, equipment storage, and vehicles.

2. All design loads must satisfy the requirements in the HFDG Section 9 and related amendments in this Schedule.

3. LRV storage floor slab must be designed for design vehicles operating load or related jacking load whichever is greater.

4. Wash bay, ROW equipment storage and LRV maintenance floor slab must be designed for design vehicles and equipment operating load or related jacking load whichever is greater.

5. Warehouse floor slab must be designed for racking loads or warehouse vehicle wheel loads (as indicated in Section 7-3.3 [*Industrial*]), whichever is greater.

6. ROW equipment storage area (interim maintenance area) building structure must be designed for the crane as described in Section 7-3.3 [*Industrial*] unless noted otherwise.

7. Llew Lawrence OMF roof structure must be designed and constructed to take full cover of roof top solar panel and corresponding support elements.

B. Serviceability Design Criteria

1. Building Type: Operation and Maintenance Facility

2. Deflection Criteria: The maximum horizontal and vertical deflections of steel framing must not exceed code-based criteria, nor the following:

a. Steel structure supporting suspended floors and roof structure must be designed to limit vertical deflections to span/360 under live load and span/240 under total load (live plus dead load).

b. Maximum total vertical deflection for long span members must be limited to 75 mm. Pre-camber as necessary and in conformance to CSA S16.

c. Maximum storey drift must be limited to span/400 and for crane lateral, crane runway girder vertical and lateral and other items refer to CISC S16.

3. Settlement of Footings and Slabs-on-Grade:

a. Total Settlement < 25 mm

b. Post construction settlement < 12 mm

c. Differential Settlement < L/500

C. Foundation Design

1. Foundation design must be done in conjunction with Section 1-3.4.1 [*Geotechnical and Environmental*] of this Schedule.

2. The Design-Builder should undertake a detailed geotechnical investigation for designing the Llew Lawrence OMF foundations.

3. The City has undertaken limited geotechnical investigation in Llew Lawrence OMF Site (Geotechnical Investigation – Llew Lawrence Operations and Maintenance Facility prepared by WSP E&I Canada Limited (WSP), dated January 09, 2023) for the preparation of this document only which is available as Disclosed Data.

4. The minimum frost cover requirements must be maintained by the Design-Builder for all the Llew Lawrence OMF foundations, except where equivalent thermal insulation is provided.

5. All exterior foundations for equipment pads, apron slabs, loading dock sloped ramps and footings, and stand-alone elements must have full depth foundations to below the frost line except where equivalent thermal and/or rigid insulation is provided by geotechnical report recommendation.

6. Grade beams or frost walls should be provided along the building perimeter and under masonry walls as required.

7. Where the underside of perimeter pile caps or grade beam or frost wall are above the frost depth, void form or other professional method based on the geotechnical report must be provided to prevent frost heaving.

8. Design-Builder must provide dewatering and/or shoring where construction occurs below the water table and as required.

9. To mitigate the effects of the high-water table at the Site and to minimize associated long-term maintenance issues, the Design-Builder must provide continuous water-stop at joints and perimeter drains for water-tight performance for below grade elements such as pits.

10. The Design-Builder must design all shoring, tiebacks, and temporary retaining structures. Foundation and below-grade walls retaining soil or rock must be reinforced concrete construction and be designed for the building and operational loads and soil conditions. The design of all shoring, tiebacks and temporary retaining structures for landscaped areas must be signed and

sealed by a Professional Engineer licensed in the Province of Alberta with expertise in these types of structures.

11. Service lines or conduits must not be placed below footings unless appropriate design protections are provided to prevent crushing or cracking. Service lines or conduits must not be placed below and parallel to foundations.

D. Building Excavation and Backfill

1. All excavations must be cut with cut-slopes depending on the on-site soils and as recommended in Design-Builder geotechnical report.

E. Gravity Load Structural Systems

1. The building's vertical gravity load framing must essentially consist of steel framed beams and columns, multiple moment frames and braced frames along grid lines and connected with axial collectors. Any other proposed structural system prepared by the Design-Builder should be reviewed as indicated in the review process.

2. All structural steel framing material must be new and free from defects or errors. Defects and errors, if any, must be corrected for uncompromised performance.

3. All building columns and vertical bracings must be truly plumb-vertical, all floor framing members must be truly horizontal as per tolerances specified by CSA S16. Such tolerances are not accumulative. The strictest tolerance shall apply.

4. Column base plates must be set on reinforced concrete upstand pedestals not less than 200 mm high in industrial space unless noted otherwise. Column base plates must be set below top of floor slab in non-industrial space.

5. The Design-Builder must design and detail the building structure to allow thermal movement of component members caused by ambient temperature range defined by the climatic data of the code for the Llew Lawrence OMF Site location, without causing any adverse buckling, failure of joint seals, and undue stress on fasteners or other detrimental effects.

6. Comprehensive design and details of connections must be in accordance with requirements of CSA S16 and CSA S136. The Design-Builder must appoint a specialty Structural Engineer, licensed in Province of Alberta, to design and authenticate all the steel connections. The comprehensive design of all moment connections and splices must be designed to develop the full capacity of the members, unless required otherwise.

7. The Design-Builder must protect all the steel surfaces exposed to soil with two coats of asphalt-based paint or similar approved professional method.

8. The Design-Builder must provide compatible preparation for all the steel surfaces which receive sprayed fireproofing.

F. Lateral Load Resisting System

1. The lateral loads from seismic, wind, and crane movements must be resisted by a lateral load resisting system to provide stable and redundant structure and meet lateral deflection criteria.

2. The locations and dimensional geometry of the lateral resisting elements must be coordinated to offer unobstructed movement while also controlling serviceability drifts and arresting torsional instabilities.

G. Interior and Exterior Walls

1. Interior partition walls in the maintenance, administration and storage spaces must be non-load bearing walls.

2. Interior partition walls in the upper level (mechanical and electrical room) must be non-load bearing walls. All interior splash walls around the wash bay pit must be water-resistant. Wash bay walls must be specially designed to ensure they are protected from the pressures and impact of jets from water spray. Where such protection is not provided, the wall design must be capable of absorbing the pressures and force from water jets and performing without the need for maintenance or replacement throughout the design Life.

3. All CMU walls must be in accordance with CSA S304.

H. Main Floor

1. The main floor must be designed and constructed as a reinforced concrete slab-on-grade based on the NBCAE loading, floor equipment and vehicle loading requirement.

2. The slab-on-grade must be sloped towards area drains and trench drains.

3. These slabs must have a non-slip finish that is compatible with air entrained concrete. Slabs-on-grade must have smooth steel trowel finish, broom finish, non-slip finish, or any combination of these to be confirmed during the detailed design phase. The Design-Builder must coordinate the type of slab finish for compatibility with requirements for air-entrainment and addition of integral or surface-applied hardeners.

4. All steel fabrications like guardrails, etc. must be incorporated in the design with concealed connections and sealants to minimize maintenance.

5. The warehouse slab-on-grade must be designed for forklift wheel loads, shelving and racking loads for pallet geometry to suit operational processes. The warehouse floor must have minimum flatness and levelness equal to 25 and 20 respectively. High quality floor flatness and levelness (Ff, Fl numbers) for pallet rack support slabs must be coordinated during final design.

6. The Design-Builder must provide a loading dock with sloped ramp, designed to geometry and location in compliance with the facility requirements. The exterior ramp slab must be provided with a herringbone grooved pattern and a trench drain at its base. At the end of the loading ramp, inside the warehouse building, a dock leveler and vehicle restraint must be detailed in the final design.

7. Design-Builder must design and construct a complete drain system to keep water away completely from building area including exterior slabs.

8. Exterior apron slabs at overhead doors must be designed as hinged-off of the building perimeter frost wall. Slabs-on-grade must be isolated along the building perimeter, and off columns. Interior slabs-on-grade to exterior aprons must run over foundation walls at door openings and at perimeter of pit-openings.

9. At mechanical and electrical rooms, all equipment must be installed on minimum 100 mm (or more based on the equipment requirement) thick reinforced concrete house-keeping pad.

10. Floor slabs must be designed to support the loading and service duty associated with vehicle maintenance, equipment, and to create slopes for surface drainage. Service duty must include maintaining the integrity and continuity of slab surface to minimize cracking and fissures that could facilitate degradation of the slab, or corrosion of reinforcement, due to vehicle or equipment loading, wear due to traffic, or presence of water and salt.

11. All exterior concrete must be designed for soil exposure class defined through Design-Builder geotechnical investigation. Moreover, all the exterior slabs exposed to de-icing salts (chlorides), must be designed for Exposure Class C-1 as well and must have a non-slip finish that is compatible with air-entrained concrete.

12. Slabs in rooms that contain hazardous liquids which must be prevented from leaking into the ground below must have reinforced concrete upstand containment curbs all around with access ramps at doors and be surface sealed with a chemical-resistant epoxy paint and water bar all around and up to at least the top of the upstand curb. These slabs must be reinforced suitably to support the loads that will be applied to them.

I. Structural Elements Located in Wet Environments

1. All new structural steel members, steel siding and steel deck located in building areas subject to wet conditions must be hot-dipped galvanized. Field welding of any such hot-dipped galvanized members to correct Site installation errors must be reviewed as indicated in the review process of Schedule 2 [*Submittal Review Procedure*]. Any new connections must be bolted connections with hot-dipped galvanized hardware. All hot dipped galvanized steel elements must be primed to receive finished painting in accordance with Appendix 5-7A [*Llew Lawrence OMF Functional Program*].

7-3.5 MECHANICAL

A. General

1. The Design-Builder must Design all mechanical systems for the Llew Lawrence OMF to incorporate energy efficiency and heat recovery initiatives.

2. The Design-Builder must provide mechanical systems in compliance with all applicable codes, standards, and regulations and with manufacturers requirements and recommendations. The HFDG and the Edmonton Facility Consultant Manual are to be followed.

3. The Design-Builder must install all floor mounted equipment on concrete housekeeping pads to keep equipment free of debris and spills. Curb depth to be not less than 100 mm.

4. Ductwork, piping, systems, and equipment to be identified as per the HFDG.

5. The Design-Builder must insulate the drainage piping, plumbing piping, hydronic piping, and ventilation systems, and related components in accordance with HFDG and ASHRAE 90.1, whichever is more stringent.

6. The Design-Builder must provide heat tracing on all piping subject to freezing temperatures. Heat tracing to be in conformance with HFDG.

7. The following design conditions must be utilized. Indoor conditions are based on owner input in combination with conditions recommended in reference standards for a particular occupancy.

Table 7-3.5.1: Outdoor Design Conditions

Outdoor Design	Outdoor Temperature	
-	Dry Bulb	Wet Bulb
Edmonton	-	-

Winter	-40°C	n/a
Summer	35°C	19°C

Table 7-3.5.2: Indoor Design Conditions

Indoor Space Design	Summer		Winter	
-	Temperature	Humidity	Temperature	Humidity
Office & Administration	23.9°C (Max.)	Min 60%	21°C C	Min. 30%
LRV Storage Areas	Variable	N/A	10°C (Min.)	N/A
LRV Maintenance Areas	Variable	N/A	18°C (Min.)	N/A
LRV Maintenance Support Areas	Variable	N/A	18°C (Min.)	N/A
Mechanical & Electrical Rooms	Variable	N/A	15°C (Min.)	N/A
Entry Vestibules	Variable	N/A	15°C (Min.)	N/A

Table 7-3.5.3: Air Filtration

Air System	Filtration Level
Exhaust Air	N/A
Return Air	N/A
Exhaust and Return Air with Energy Recovery	MERV 8
Outdoor Air Pre-Filters (Summer)	MERV 8
Outdoor Air Pre-Filters (Winter)	MERV 8
Supply Air	MERV 13

Table 7-3.5.4: Sound Levels

Space	Maximum NC/dBA
Offices	30
Meeting Rooms	30

Corridors & Support Areas	35
Service Spaces	50/80

Service Spaces that the Maximum NC 50 or 80 dBA is applicable to are:

a) B113 Main Network Access Room

b) B124 Fire Pump Sprinkler Room

c) B125 Wash Bay Mechanical Room

d) B127 Electrical Service Room

e) B130 Emergency Electrical Room

f) B147 Freight Elevator Machine Room

g) B204 Service Room

h) B301 Mechanical Service Room

i) Communication Rooms/Network Access Rooms (various)

j) Blowers in wash rack rated at 87 dBA are acceptable

8. Ventilation and exhaust requirements will follow ASHRAE Standard 62.1 and NBC(AE) 2019. In general, the minimum outdoor air flow or exhaust air flow rates as applicable will meet the most stringent requirements. For the basis of design, the following rates have been used:

   a. LRV Storage: 2.54 l/s per square meter (0.5 cfm per square foot);

   b. ROW Equipment: 10.16 l/s per square meter (2.0 cfm per square foot);

   c. Cleaning Lanes: 7.62 l/s per square meter (1.50 cfm per square foot);

   d. Wash Bay: 5.08 l/s per square meter (1.00 cfm per square foot) when the wash bay is not in use and increased per the wash bay equipment manufacturer's requirements when the wash bay is in use;

   e. Inspection Pits: 7.62 l/s per square meter (1.50 cfm per square foot);

   f. Interim Maintenance Lanes: 10.16 l/s per square meter (2.0 cfm per square foot); and

   g. Office/Administration: Per ASHRAE 62.1.

B. Testing, Adjusting, and Balancing (TAB)

1. The Design-Builder must perform TAB for all mechanical systems by an agency certified by Associated Air Balance Council or National Environmental Balancing Bureau and according to the Testing and Commissioning Plan to be developed by the Design-Builder.

C. Commissioning

1. The Design-Builder must carry out commissioning activities in compliance with LEED® Silver certification requirements and such that warranties are not violated or adversely compromised. Refer to the Commissioning Consultant Manual.

D. Vibration Requirements

1. The Design-Builder must Design and install all mechanical systems and equipment to mitigate the transmission of vibration and noise to any part of the building, including but not limited to offices, staff amenities rooms, and meeting rooms.

2. The Design-Builder must provide vibration isolators to mechanical equipment and components.

3. The Design-Builder must isolate all mechanical equipment or components including piping and ductwork and all equipment from the building structure.

4. The Design-Builder must provide vibration isolation in the pipes and/or ducts connections to dynamic equipment such as, fans, pumps, etc.

5. Select equipment isolators and other components as indicated to satisfy the following requirements:

Type	Minimum Static Deflection in mm (ins) Equipment Supported By:	
	Slab on Grade	Elevated Slab
Reciprocating Compressors	19 (¾)	38 (1½)
In-Line Pumps:		
Under 1.5 kW (2 HP)	1 (1/16)	3 (⅛)
1.5 kW (2 HP) to 11.5 kW (15 HP)	3 (⅛)	5 (¼)
Over 11.5 kW (15 HP)	3 (⅛)	9 (⅜)
Base Mounted Pumps:		
Under 5.5 kW (7.5 HP)	5 (¼)	19 (¾)
5.5 kW (7.5 HP) and greater	19 (¾)	38 (1½)
Fans, Blowers and Packaged Air-Handling Units:		
Under 0.35 kW (0.5 HP)	1 (1/16)	1 (1/16)
0.35 kW (0.5 HP) to 5.5kW (7.5 HP)	25 (1)	25 (1)
5.5 kW (7.5 HP) to 30kW (40 HP) - up to 400 rpm	38 (1½)	38 (1½)
5.5 kW (7.5 HP) to 30 kW (40 HP) - over 400 rpm	25 (1)	25 (1)
Over 30 kW (40 HP) – up to 400 rpm	38 (1½)	38 (1½)

Notes:

1. Table indicates required static deflection of isolators for all fans regardless of power rating and for all other motor driven equipment over 0.37 kW (0.5 HP).

2. Advise consultant of equipment not contained in this table and obtain clarification as to the isolation performance requirements.

3. Steel spring isolators shall be used for all deflections 12 mm (½") and over.

4. Neoprene isolators shall be used for deflections 6 mm (¼") and under.

E. Equipment Maintainability and Location

1. Mechanical equipment must be serviceable with a ladder no higher than 3050 mm. When a ladder is required, it must stand on a safe non-slippery surface with enough room to circulate around it and maintain a minimum inclination ratio of 4:1. Equipment locations must avoid areas where maintenance activities would result in unsafe conditions for staff and patrons or would result in unacceptable impacts to normal facility operation.

2. The Design-Builder must provide sufficient space around mechanical equipment and in service routes for ease of maintenance and operation in accordance with manufacturer's recommendations and for equipment replacement. Maintenance areas must have a minimum height of 2.1 m.

3. The Design-Builder must locate mechanical equipment and services such that it does not interfere with any shop operations and must protect exposed services from potential damage from shop operations.

F. Sanitary Drainage

1. The Design-Builder must provide a sanitary drainage system such that all Llew Lawrence OMF drains discharge by gravity to the sanitary piping system and are vented to atmosphere.

2. The Design-Builder must discharge all sanitary drainage to the City's sanitary sewer system. Refer to Section 7-3.8 for additional information on tie-in to the City's sanitary sewer system.

3. Drainage, including equipment requiring drainage, must not be located within or directly above any room where communications, signaling, or electronic equipment (excluding end devices) will be located, or any operationally critical rooms. Where drainage must pass above the rooms noted above, a drain pan is to be provided below the piping. A drain from the drain pan is to be piped to the nearest indirect drain. Provide a moisture sensor in the drain pan which is to be monitored by the BMS.

4. The Design-Builder must use piping materials and fittings in conformance with HFDG.

5. The Design-Builder must Design and install drainage systems in accordance with codes, standards and authorities having jurisdiction. Systems must include sanitary system and venting system.

6. The Design-Builder must provide grit and oil separators, effluent neutralizers, and sediment and fluid capture systems, as required, and provide a separate drainage system for areas subject to contamination, ensuring drainage is discharged to the main sanitary system only after the contamination has been separated or neutralized. Floor drains must be provided in all areas, shafts or rooms where any source of water can be expected.

7. The Design-Builder must provide local floor drains to capture water from cleaning, leakage, sprinkler and standpipe systems, and equipment requiring drainage, including, but not limited to:

a. mechanical rooms;

b. maintenance workshops;

c. all vehicle maintenance bays, with a minimum of one drain per 100 m2; and

d. any space within the Llew Lawrence OMF with low points.

8. The Design-Builder must provide the sanitary drainage system to serve the following locations:

a. any room with a sink;

b. any room with a toilet; and

c. any room that has a urinal.

9. Provide hub drains outside of comm or electrical rooms for condensate from air conditions units where drain cannot connect to a sink or other fixture.

10. The Design-Builder must ensure that all drains are primed by an electronic trap primer monitored by the BMS.

11. All cleanouts must be brought up to floor level.

12. The Design-Builder must scope all underground piping prior to the slab being poured and again no more than one month prior to building turnover. Run water through piping prior to scoping the piping to identify any locations where water may pool.

G. Storm Drainage

1. The Design-Builder must Design and install storm systems in accordance with codes, standards and authorities having jurisdiction. Systems must include storm system and venting system.

2. The Design-Builder must provide the interception of outside storm water at the Llew Lawrence OMF entrances.

3. The Design-Builder must ensure that the storm system is sized to handle all expected stormwater flows including seepage, storm drainage, and subsoil drainage.

4. Where subsoil drainage is utilized, a sediment pit must be provided before the water enters the sump.

5. Subsoil drainage pipes must be rigid, with cleanouts accessible from the inside of the building.

6. The Design-Builder must use piping materials and fittings in conformance with HFDG.

7. Roof drains to be full flow. Provide overflow connections as required by the National Plumbing Code.

8. The Design-Builder must scope all underground piping prior to the slab being poured and again no more than one month prior to building turnover. Run water through piping prior to scoping the piping to identify any locations where water may pool.

H. Plumbing

1. The Design-Builder must do a flow test and use results of the flow test for the plumbing system Design.

2. The Design-Builder must not route piping through, or directly above, any room where communications, signaling, or electronic equipment (excluding end devices) will be located, to protect against water leakage and damage to equipment in these areas.

3. The Design-Builder must use piping materials and fittings in conformance with HFDG. Piping installed in high humidity areas is to be corrosion resistant.

4. The Design-Builder must Design and install plumbing systems in accordance with codes, standards and authorities having jurisdiction. Systems must include potable hot and cold water systems, and domestic hot water recirculation. Any fixture with a branch connection greater than 15 m will require a domestic hot water recirculation connection. Provide domestic hot water recirculation connections at hands-free fixture(s). Recirculation piping shall include balancing valves to maintain water velocities below 0.9 m/s.

5. The Design-Builder must ensure that domestic hot water generating systems meet the requirements of NECB or ASHRAE 90.1. Except for systems for isolated or short branch lengths, domestic hot water systems must be provided with recirculation systems and two or more commercial grade water heaters, meeting the requirements of ASHRAE 90.1, latest edition. Refer to HFDG for specific requirements for domestic hot water heaters.

6. The Design-Builder must consider water hammer, backflow prevention and thermal expansion.

7. The Design-Builder must select pipes suitable for the service and pressure.

8. The Design-Builder must provide isolation valves to allow for localized shut down of equipment and fixtures for ease of maintenance and service. Rooms with more than one plumbing fixture are to have general isolation valves.

9. The Design-Builder must protect piping from condensation.

10. The Design-Builder must coordinate with the City for the installation of water meters for potable water.

I. Plumbing Fixtures

1. General Requirements

a. Plumbing fixtures must be provided in accordance with the Edmonton Facility Consultant Manual.

b. Additional plumbing fixtures are summarized as follows but not limited to:

i. Multi-station Wash Sink: Three-station, stainless steel wall mount basin, linear arrangement, with individual automatic, infrared sensor activated faucets.

2. The Design-Builder must ensure that plumbing fixtures are low consumption, meeting or exceeding the NBCAE and must meet the requirements for LEED® Silver certification. Refer to Section 7-2.3 [*Sustainable Buildings and Infrastructure Rating Systems*].

3. The Design-Builder must provide fixed eye and face wash stations and emergency showers supplied with tempered water to meet the requirements of HFDG, ANSI Z358.1. and CSA B64.10.

4. The Design-Builder must provide a minimum of two permanent fixed eye wash facility and one permanent fixed eye/shower station accessible to every maintenance track.

5. The Design-Builder must provide a minimum of one permanent fixed eye wash facility at every second storage track.

6. The Design-Builder must provide hose bibs for the following areas:

    a. Mechanical rooms (one hose bibb for each 375 m2 of mechanical room floor area)

    b. Washrooms (one hose bibb at each washroom)

7. External hose bibs must wall recessed, lockable, and non-freeze type, and are to be provided for the following areas:

    a. Personnel entry ways

    b. Roof level to facilitate cleaning of roof monitors. Quantity required a needed to reach all roof monitors with a 30 m hose.

    c. Other locations required to permit cleaning and maintenance of building components.

J. Sumps, Sump Pumps, and Sewage Ejectors

1. The Design-Builder must provide sump pumps, sumps and sewage ejectors, as follows:

    a. Where the waste discharge sump is located below the invert level of the City's gravity sanitary piping system, collection sumps with duplex pumps or ejector tanks with duplex pumps must be provided to discharge to the sanitary gravity main within the building.

    b. Where storm drainage to the relevant City's gravity storm piping system is not practicable, the Design-Builder must provide sump pump stations with duplex pumps for sub-surface storm drainage.

    c. The system must be Designed to identify the location of any flow blockages and have sufficient access to remove any blockages.

    d. Each pumping station must include a sump pit, lift-out rails, access covers flush to the slab, pumps, water level controllers, and pump control panel.

    e. Pump sets must be of either the submersible or self-priming type. Pump and sump pit must be Designed for handling grit through interception and pumping if the upstream piping can be reasonably expected to include the same.

    f. Pump selection and the number of pumps must be Designed to accommodate the Design flow rates, including seepage flows, at all times. All sump pump systems must have two pumps configured in a duty/standby duplex arrangement and should operate in stages based on predetermined water levels monitored by the sump water level monitoring system.

    g. Pumping stations must be configured to allow pumps and accessories to be retrieved for servicing without requiring confined space entry.

    h. Each pump must be sized for 110% of the expected load.

    i. Provide an elevator sump pump in shafts where there is a hydraulic lift or where fire sprinklers are installed. Where pumps are installed in a shaft with a hydraulic lift, the pumps must be controlled by an oil/water sensor.

2. Pumping Station Control Panel

    a. Control panels and all accessories - including cable connectors, fittings, indicating lights, push buttons and supporting mountings - must be constructed of materials to suit the environment exposed to dust, dirt, and moisture.

b. Control panels must operate the pumps in stages based on pre-determined water levels monitored by the sump water level monitoring system.

c. Control panels must facilitate local indicating lights and warning lights and provide alarm(s) back to the BMS.

d. The sump pump control panels must provide dry contacts on sump control panels to send the following pump failure and HWL alarms that are separate to the BMS.

K. Heating, Ventilation, and Air Conditioning Systems

1. Design-Builder to refer to the HFDG and the Edmonton Facility Consultant Manual for heating, ventilation, and air conditioning Design parameters.

2. The Design-Builder must Design systems for high efficiency to meet or exceed applicable ASHRAE standards or requirements and to ensure compliance with the NBCAE.

3. System concepts must be based on the energy conservation guidelines of the NECB, NBCAE, ASHRAE 90.1, LEED® certification, as well as the ventilation standard of ASHRAE 62.1. Note that the most stringent condition shall apply. Applicable version of codes and standards to be approved by Authority Having Jurisdiction.

4. Energy efficiency must be optimized to meet or exceed ASHRAE standards as required for LEED® Silver certification. Refer to Section 7-2.3 [*Sustainable Buildings and Infrastructure Rating Systems*].

5. Heat recovery systems, as well as free cooling and other active and passive HVAC load-reduction strategies, must be utilized to facilitate energy conservation. HVAC systems must control building pressurization to protect occupied non-maintenance areas from odours and pollutants. Administration and warehouse areas to positively pressurized with respect the maintenance and storage areas.

6. The Design-Builder must Design systems for the Llew Lawrence OMF to meet personal comfort conditions and provide personnel protection against operations which produce airborne particles and fumes. Refer to ASHRAE Standard 55 and the HFDG the most stringent conditions shall apply.

7. The Design-Builder must Design systems as applicable to satisfy the requirements for ventilation, supply, exhaust, make-up air, and cooling (where required) of all areas and equipment, and that of the various maintenance and repair operations to be undertaken within the Llew Lawrence OMF.

8. Exhaust air requirements of maintenance floor areas must be as per ASHRAE 62.1 and ventilation of maintenance pit areas must comply with NFPA 30A.

9. Rooms that contain equipment that may give off airborne particles, fumes, or odours must be exhausted to the outside. Washrooms must be exhausted to the outside. All exhaust shall be directed through heat recovery units with exception to the following areas which are to be directly exhausted to the outdoors:

a. Hazardous storage room

b. Battery charging

c. Paint booth

10. The Design-Builder must ventilate rooms containing refrigerant in accordance with CSA B52 Mechanical Refrigeration Code.

11. Room and spaces containing rechargeable acid batteries must be naturally or mechanical ventilated to keep hydrogen in the air below 1%. The Design-Builder must exhaust these rooms and spaces requiring mechanical ventilation to outside using dedicated exhaust fan(s). Fan operation to be interlocked with charging system operation.

12. The Design-Builder must coordinate appropriate mechanical systems and equipment for electrically classified areas.

13. The Design-Builder must provide air conditioning systems for electrical rooms, communication rooms, and server rooms in accordance with HFDG. Redundancy requirements are outlined in the HFDG. Cooling equipment located outdoors must be Designed to operate at winter low ambient temperatures to -40˚C and summer temperatures of 37˚C.

14. External ambient temperature Design conditions must be based on the HFDG.

15. Indoor temperature at the maintenance pits must be maintained above 18°C.

16. Provide heating and ventilation systems to prevent condensation on glazing and facility surfaces.

17. Ductwork materials, construction, joints, fittings, and accessories must be in accordance with the SMACNA standards with Class A seal.

18. Flexible duct is only allowed in the final 900 mm connection to a diffuser of grille within a ceiling plenum space and must be installed totally extended and without any curves exceeding 30°.

19. The Design-Builder must equip supply registers and grilles with opposed-blade, adjustable volume dampers.

20. The Design-Builder must provide adjustable volume dampers in ductwork mains as required to facilitate balancing branch ductwork.

21. Intake and exhaust wall louvres must be weather-resistant extruded aluminum construction.

22. The Design-Builder must provide motorized dampers in compliance with codes and standards and where redundant systems are provided. Motorized dampers on outdoor air ducts and exhaust air ducts communicating with the outdoors must be installed at the exterior wall/roof penetration and must be thermally insulated.

23. The Design-Builder must provide externally applied thermal insulation for the ductwork in compliance with NECB or ASHRAE 90.1 latest edition, whichever is more stringent.

24. Interconnecting ductwork between adjacent spaces, including men’s and women’s washrooms, must be acoustically lined to limit sound transmission and have at least one 90° elbow and no direct vision through the piece of duct.

25. Ductwork buried in floor slabs should not be used. If unavoidable, ductwork buried in floor slabs must be stainless steel or other proprietary duct system with sloping and drainage and load bearing, non-corrodible and accessible characteristics.

26. Ductwork, grilles and accessories, located in the wash bay must be stainless steel suitable for installation in wet environments.

27. Non-maintenance areas and rooms containing equipment that requires condition control must be rated minimum MERV13 or higher (ASHRAE 52.2) filter or equivalent final filter and minimum MERV8 (ASHRAE 52.2) pre-filter.

28. Maintenance areas must be provided with air filtered to minimum MERV13 (ASHRAE 52.2) rating at all times.

29. Exhaust air streams to heat recovery devices must be provided with air filtration to a minimum MERV 8 (ASHRAE 52.2) rating.

30. The Design-Builder must provide HVAC systems such that rooms subject to infiltration of dust from train movements or train maintenance activities must have HVAC systems that provide positive room pressurization.

31. Mechanical equipment and systems must be Designed that the maximum noise transmitted by the systems does not exceed Applicable Law and regulations and ASHRAE standards. Selection of equipment and systems Design must be such that the noise generated by the equipment or system does not contribute to exceeding the required general area or room noise criteria. Notwithstanding maximum noise limits for all maintenance areas must not exceed 62 dBA.

32. Non-maintenance area rooms that are occupied or frequently occupied must have a noise criteria rating not exceeding NC 40. Noise limits for conference and meeting rooms, communication and similar areas will not exceed a NC rating of 30.

33. Noise propagation to neighbouring properties from equipment operation and testing must not violate the Community Standards Bylaw, as applicable.

34. Pulse meters must be provided to monitor and verify consumption for all utilities, which must be integrated with the BMS. Pulse meters and sub-meters for sub-systems must comply with IPMVP and the Measurement and Verification Plan to be developed by the Design-Builder. Data from these pulse meters must be made available to the end client.

35. The Design-Builder must operate and maintain a gas detection system for the maintenance, cleaning lanes, warehouse areas, and storage lanes in accordance with the following requirements:

Contaminant	First stage alarm	Second stage alarm: investigation stage	Third stage alarm: emergency / purge mode	Action/Specific Notes
CO	20 ppm (5 minutes running average)	40 ppm (5 minutes running average)	50 ppm (5 minutes running average)	First Stage: Activate low (first stage) level indicator light on main control panel and modulate ventilation system(s) to reduce concentration below threshold. Send notification to BMS. Second Stage: Activate second level indicator light and audible alarm on main control panel. Send alarm to BMS. Operate ventilation system(s) at 100% capacity and investigate reason for alarm. Third Stage: Activate third level indicator light and audible alarm on main gas system control panel in the Station. Send alarm to BMS and initiate Station evacuation. Operate ventilation system(s)

Contaminant	First stage alarm	Second stage alarm: investigation stage	Third stage alarm: emergency / purge mode	Action/Specific Notes
				at full capacity.
CO2	2,000 ppm (5 minutes running average)	4,000 ppm (5 minutes running average)	5,000 ppm (5 minutes running average)	First Stage: Activate low (first stage) level indicator light on main control panel and modulate public space ventilation system(s) to maintain concentration below first stage. Send notification to BMS. Second stage: Activate second level indicator light on the main control panel in the Station. Send alarm to BMS. Operate ventilation system(s) at full capacity and investigate reason for alarm. Third Stage: Activate third level indicator light/audible alarm on the main control panel in the Station. Send Alarm to BMS and initiate Station evacuation. Shut down ventilation systems and activate Tunnel Ventilation System(s) in purge mode.
NO2	0.4 ppm (5 minutes running average)	0.8 ppm (5 minutes running average)	1.0 ppm (5 minutes running average)	First Stage: Activate low level indicator light on main control panel in the Station and modulate ventilation system(s) to reduce concentration below threshold. Sent notification to BMS. Second Stage: Activate second level indicator light and audible alarm on main control panel. Send notification to BMS. Operate ventilation system(s) at 100% capacity and investigate reason for alarm. Third stage: Activate third level indicator light and audible alarm on main control panel in the Station. Send alarm to BMS and initiate Station evacuation. Operate ventilation system(s) at full capacity.

36. LEL monitoring and related ventilation controls is not required in the storage lanes, Hazardous Material and Waste Oil Storage Room and Lubricant/Fluids Room.

37. The battery charging station to be complete with a hydrogen (H_2) gas detection system and associated ventilation system.

38. The gas detection must control the related mechanical equipment directly. The BMS will only monitor the gas detection system.

39. The Design-Builder must test and calibrate the equipment during start-up and commissioning in accordance with the manufacturer's specifications. The Design-Builder must provide, for each gas detection system at the facility, two complete testing kits (including gas bottles) for testing and calibration.

40. All notifications and alarms must be communicated and monitored at the BMS.

41. Ductwork will be sized considering a balance between operational energy costs and first installation costs, considering a system life of 50 years. Medium velocity and high velocity ductwork systems will not be permitted as per the HFDG.

42. The fixed ventilation rates noted in the Design report are prescribed based on the use cases for the spaces. The Design-Builder must consider identification of the specific air contaminants the drive the ventilation requirements, adding a sensor array to directly measure these contaminants, and implementing a demand-controlled ventilation scheme with variable air volume. This would greatly reduce the fan power to ventilate the space as well as the HVAC energy required to condition the ventilation air.

L. HVAC Equipment

1. The Design-Builder must select equipment utilizing refrigerant that meets the requirements of the LEED® application for the facility. Use of CFC and HCFC refrigerants are prohibited.

2. The Design-Builder must locate condensing units to minimize an exposure to dust.

3. The Design-Builder must select equipment to meet minimum efficiency requirements as required by ASHRAE 90.1 and NBCAE or as required to meet the Sustainability Targets as outlined in Section 7-2.3.A [*Sustainable Buildings and Infrastructure Rating Systems*].

4. Where mechanical infrastructure crosses expansion joints, or other places where differential lateral displacement may occur, the piping, ducts, etc., must be attached in a manner that accommodates the differential movement.

5. All equipment must be isolated from the building structure.

6. Floor-mounted equipment must be placed on housekeeping pads designed to facilitate the weight and inertia of the equipment.

7. Roof mounted and other outdoor equipment selection must include aesthetic considerations and be located above the expected snow accumulation level.

8. Vehicle doors and other overhead doors must be provided with dedicated air curtains which operate during door open periods.

9. Mechanical equipment located in the wash bay must be stainless steel suitable for installation in wet environments.

10. Modulating gas-fired radiant heaters are to be provided in the storage lanes and cleaning lanes to heat the LRVs. The infrared heaters are to have a vacuum pump with a VFD located in the controller. Provide top and side reflectors on burners and tail pipes.

11. Provide gas-fired infrared heaters, with high efficiency reflectors, in the wash bay that are suitable for harsh environments. Outside air to be ducted from the outside of the building.

12. Gas-fired heaters to be controlled by means of distributed occupancy sensors and thermostats.

13. Air handling units must be sized for a maximum air velocity of 2.25 m/s through the coil.

14. Air handling units are to be located indoors.

15. All air handling unit heating and cooling coil sections are to be provided with condensate pans and drains.

16. Heat recovery systems must be sized so the failure of the largest capacity portion of any heat recovery unit does not exceed 150 kW. Heating coils are to be sized to accommodate the failure of the heat recovery section.

M. Radon Systems

1. The Design-Builder must provide a complete radon extraction system complete with dedicated exhaust fans and interconnecting PVC piping (minimum pipe size to be 100 mm diameter) to pits as required and terminate piping through the roof. Radon collection systems must be Designed to NBCAE and EPA guidelines. Provide a Radon Mitigation Plan in accordance with the Edmonton Facility Consultant Manual.

N. Hydronic Systems

1. The Design-Builder must slope, support, and anchor pipework to maintain the integrity of all systems under all operating conditions.

2. The Design-Builder must provide all valves and accessories for equipment isolation installed in accessible locations.

3. The Design-Builder must provide piping systems with freeze protection, expansion relief, and protection from vibration and noise transmission to the structure and thermal insulation to meet NECB(AE) or ASHRAE 90.1, whichever is more stringent.

4. Heating systems must be integrated with cooling systems to avoid any simultaneous heating and cooling.

5. All piping systems including fittings, flanges, valves, and accessories must comply with ANSI, CSA and NBCAE standards. Pipework must be sloped supported and anchored to maintain the integrity of all systems under all operating conditions. All valves and accessories must be provided for equipment isolation and installed in accessible locations.

6. Boilers and components must be low-emission, natural gas-fired condensing type, manufactured to ASME certifications, including associated safety valves. Multiple boilers must be installed with monitoring or controlling system to obtain maximum performance and efficiency. The central heating plant is to be Designed with redundancy to accommodate for the failure of various system components in accordance with the Edmonton Facility Consultant Manual.

7. Water treatment must be provided for all closed loop hydronic systems.

8. Provide Alberta Boiler Safety Association (ABSA) certification and inspections as required by code.

9. The load in the coils will be controlled with control valves and balancing valves.

10. HVAC piping must be sized with a maximum pressure drop of 300 Pa/m and a maximum velocity of 2 m/s.

11. Hydronic distribution pumps are to be selected with variable frequency drives to modulate the fluid flowrate to correspond with actual system demands.

O. Building Management Systems

1. The Design-Builder must provide local control and monitoring of the building systems with a non-proprietary system that is compatible with the City's network system, the HFDG, and the Edmonton Facility Consultant Manual. All building controllers, application controllers and input/output devices must use industry standard protocols.

2. The Design-Builder must provide BMS to include data server, BACnet/IP network, network controllers, field controllers complete with local display terminals, application specific controllers, local and PC-based control panels, and contact for the SCADA system. In addition to the SCADA system, the BMS must be able to communicate and send information to other remote City of Edmonton Centres. The City has a dedicated BMS. The Design-Builder must coordinate the requirements of the BMS with the City. Design and documentation of the BMS has to comply with the HFDG.

3. HVAC controls plus the control and monitoring point settings must be integrated within the overall Llew Lawrence OMF BMS.

4. Facilities must be provided for operation of all systems in a fully manual mode, whenever required, independent of the BMS.

5. Local control panels must be located for ease of access and operation and protected from damage from shop operations.

6. The Design-Builder must ensure that all energy monitoring data is communicated in near real time to the energy management system.

7. The Design-Builder must ensure that each item of equipment managed through the BMS must have a local control panel, independent of the BMS, to provide fallback operation of the equipment.

8. The Design-Builder must ensure that no single point of failure, or no common cause failure, impacts BMS functionality or performance such that it creates a hazard to the safety and security of the users.

9. Control systems for occupied and frequently occupied rooms must be capable of resetting to unoccupied-mode operation such as energy recovery, night setback, and economizer controls.

10. Local safety alarms must be provided throughout the Llew Lawrence OMF and alarm signals transmitted to the BMS.

11. HVAC system controllers must be part of the BMS. All control points must be hardwired to the BMS. Equipment that has BACNet or other communication protocols must have both connections, with the controls based on the hardwired points and the other communications services as source of information.

12. Equipment safety alarms, fire and smoke alarms must switch off or otherwise control applicable ventilation equipment.

13. The BMS must integrate multiple building functions including equipment supervision and control, alarm management, energy management, information management, and continuous historical data collection, and archiving.

14. Energy recovery, night setback, and economizer controls must be provided as well as heating and cooling controls capable of resetting space temperature in unoccupied mode for occupied non-maintenance areas.

15. Historical trending and data collection: Trend and store point history data for a period of two years for all BMS points and values as selected by the user. The trend data must be stored in a manner that allows custom queries and reports using industry-standard software tools.

16. The Design-Builder must provide the BMS such that for occupied spaces, occupants are able to control their room temperature.

17. Individual room or zone temperature sensors, CO_2 sensors, occupancy sensors and on-off controls for off-hours must control ventilation motorized dampers, heating and/or cooling coils to maintain space temperature set points for occupied non-maintenance areas.

18. Non-maintenance areas with variable occupant densities such as training, meeting and conference rooms must have CO_2 sensors to control the outdoor air ventilation rate.

19. CO_2, CO, NOX, H_2, LEL and other gas sensors must control relevant ventilation systems where vehicle exhaust emissions are likely.

20. For maintenance areas, ventilating units must be controlled by time-of-day schedules and other sensors located in representative locations with provisions for off-hour manual override control with operator-adjustable run time.

21. The Design-Builder must provide local alarms which are actuated through the BMS to indicate when vehicle doors have been open too long. The BMS must be capable of notifying the specific alarm and relevant details and include door opening data. Safety systems must be installed to prevent doors from closing if the door opening is occupied and/or an equipment move (consist, LRV, locomotive, forklift, etc.) into the doorway is imminent.

22. The Design-Builder must provide filters with differential pressure gauges and switches that will automatically alert facility personnel when filters require replacement.

23. The BMS must also monitor the operational and alarm status of other mechanical systems such as sump pumps and drainage interceptors, water and electricity meters and systems, fire protection systems, gas monitoring systems, elevator alarms, and hydronic heating systems.

P. Fire Protection

1. The Design-Builder must provide fire protection systems, as follows:

   a. The Design-Builder must provide fire protection systems as required by the HFDG, NBCAE, NFPA, and applicable codes, regulations and standards and as described in these articles.

   b. The Design-Builder must do a flow test and use results of the flow test for hydraulic calculations.

c. The fire protection systems are to be hydraulically Designed to deliver the densities over the most remote areas in accordance with the NFPA. Hydraulic calculation must start at the fire pump connection.

d. Where required, fire pumps must be provided with a continuous or emergency power source, and supervisory controls.

e. The Design-Builder must provide backflow prevention with detector check for systems that interface with the public water system.

f. Portable fire extinguishers must be provided in accordance with applicable codes and standards.

g. Fire department connections must be wall-mounted and with signage constructed of polished bronze or chrome plated bronze. The Design-Builder must verify the type required by City. Location of fire department connections must be approved by the City.

h. Provide sprinkler protection for under all platforms including shelving platforms, in-rack sprinklers, roll-up doors, stairs, mezzanine stairs, or any other obstructions wider than 1200 mm.

2. The Design-Builder must provide fire protection for maintenance shops and associated offices, as follows:

a. The Design-Builder must provide wet sprinkler installations according to the hazard classification of the diverse areas of the maintenance shops and associated offices. Systems must suit applications such as service areas where sprinkler heads are prone to damage and temperature ranges (high and low) of spaces.

b. The Design-Builder must provide dry sprinkler installations where freezing temperatures are practicable. The LRV storage lanes are to be protected by dry sprinkler system(s). The dry sprinkler system may use either nitrogen generator(s) or compressed air.

c. The Design-Builder must provide clean agent fire suppression system to protect communications equipment rooms, signal rooms, Traction Power rooms, and electronic equipment rooms.

d. In shop areas, fire protection cabinets must be provided as required by code and positioned and protected to minimize impact on shop operations and damage from vehicles. Individual fire extinguishers must be similarly protected.

e. The Design-Builder must provide ESFR sprinkler heads in areas with high storage in lieu of in-rack sprinkler heads.

f. The Design-Builder must provide sprinkler protection under overhead doors.

Q. Specialty Systems

1. The Design-Builder must provide the following specialty systems:

a. Central Vacuum System

i. The vacuum must be of sheet steel construction of the multi-stage centrifugal type. The vacuum producer must be built in standard overhung type construction with the impellers mounted directly on the extended motor shaft to ensure constant operating efficiency.

ii. The motor must be capable of continuous-duty operation without usage of the motor service factor.

iii. The vacuum producer must be equipped with an electronic monitoring bleed control. The surge device must be installed in the common air line between the separator outlet and the vacuum producer inlet.

iv. The system must be furnished with a tubular bag separator complete with a removable dirt can. The separator must contain tubular stocking type filter bags.

v. The separator must be equipped with an external manual bag shaker for cleaning the bags at regular intervals.

vi. Refer to the HFDG for full central vacuum system requirements.

vii. Ten vacuum drops with hose reels must be provided in the cleaning lanes. Allow for four drops in operation concurrently. Final quantity of connections required to be confirmed with the City.

b. Synthetic Gear Lubricant Distribution System

i. The Design-Builder must provide a synthetic gear lubricant system with two air operated diaphragm pumps (primary and standby). Each pump must be capable of supplying 6.0 lpm simultaneously at three dispensing locations for a total of 18 lpm.

ii. The Design-Builder must provide five hose reel racks with a dispensing gun complete with meters, racks, and drip trays with two hose reel racks in the maintenance pit and two hose reel racks adjacent to Track R1. Another hose reel station is required in the deep cleaning pit on Track W1.

iii. Allow for a 1500 litre storage tank (minimum) in tank storage room. Provide fill line and vent to exterior wall.

c. Hydraulic Oil Distribution System

i. The Design-Builder must provide a hydraulic oil system with two air operated diaphragm pumps (primary and standby). Each pump is to be capable of supplying 1.0 lpm simultaneously at three dispensing locations for a total of 3 lpm.

ii. The Design-Builder must provide five hose reel locations with a dispensing gun, racks, and drip trays with two hose reel stations in the maintenance pit and two hose reel stations adjacent to Track R1. Another hose reel station is required in the deep cleaning pit on Track W1.

iii. The Design-Builder is to provide space for 4 - 55 gal drums on a containment pallet for hydraulic oil.

d. Grease Distribution System

i. The Design-Builder must provide a grease system with two air operated diaphragm pumps (primary and standby). Each pump must be capable of supplying 1.0 lpm simultaneously at three dispensing locations for a total of 3 lpm.

ii. The Design-Builder must provide five hose reel locations with a dispensing gun, racks, and drip trays with two hose reel stations in the maintenance pit and two hose reel stations adjacent to Track R1. Another hose reel station is required in the deep cleaning pit on Track W1.

e. Waste Oil System

i. The Design-Builder must provide waste oil transfer systems in the maintenance pits.

ii. The Design-Builder must provide one transfer stations to be piped back to the oil storage room. Final quantity of connections required to be confirmed with the City.

iii. Allow for 1500 litre storage tank located outside adjacent to tank storage room. Provide fill line from exterior wall.

f. Compressed Air

i. The Design-Builder must provide a compressed air system to serve hose reels, train wash system equipment, and air operated diaphragm pumps. If the Design-Builder elects to use this system for the sand conveyance system, the sand conveyance portion of the system must provide dried air.

ii. The Design-Builder must provide a minimum of two air compressors with integral dryers along with air receivers. Design-Builder to coordinate delivery pressure and flow rate with distributed equipment operating parameters.

2. The Design-Builder is responsible for registering all flammable and combustible liquid storage tanks and waste oil tanks as required by the City.

R. Stage 1 Base Scope Considerations

1. The Design-Builder must:

a. allow space in service rooms for future installation of ventilation systems for the Ultimate Buildout.

b. right-size the boiler plant for Stage 1 operation providing boiler header pipe sized for the Ultimate Buildout.

c. allow for capped connections for additional secondary loops for future ventilation and heating systems for the Ultimate Buildout.

d. size the Incoming gas service for the Ultimate Buildout gas load.

e. ensure that the BMS is expandable to accommodate the Ultimate Buildout.

f. size domestic hot water generation for the Ultimate Buildout.

g. provide capped connections for plumbing distribution at locations of future expansions for the Ultimate Buildout.

h. ensure that storm and sanitary drainage system is provided with capped connections for the Ultimate Buildout with inverts set accordingly.

i. size the fire pump for the Ultimate Buildout and provide capped connections at sprinkler header for future expansions to the Ultimate Buildout.

j. size central specialty systems to accommodate the Ultimate Buildout with capped connections provided for future expansions.

k. right-size the central compressed air system for current operation and provide compressed air header pipe sized for the Ultimate Buildout. The Design-Builder must provide a capped connection for the maintenance bays for future implementation.

l. size ventilation systems and duct distribution in ROW to accommodate a maintenance pit.

m. the ventilation system distribution from the mechanical room to ROW to accommodate the administration area layout changes.

n. adjust the administration ventilation system to accommodate the revised layout.

o. review the requirements for a lift station for maintenance pit in ROW and provide if required.

7-3.6 ELECTRICAL

7-3.6.1 Electrical System Description and Requirements

A. The Llew Lawrence OMF must be supplied with two 25 kV feeders to a double ended unit substation with two 3500 kVA step-down transformers located at the Llew Lawrence OMF. The unit substation will transform the voltage to 600 V for distribution within the Llew Lawrence OMF. The 600 V, three phase service will run from the transformer location in concrete encased underground conduits to the switchboards located in the Llew Lawrence OMF main electrical room.

7-3.6.2 Electrical Load

7-3.6.2.1 Essential Power (Utility and Emergency Generator)

A. A 750 KVA, 600 V emergency generator must be provided at the Llew Lawrence OMF Site near the Utility Complex to power the life safety loads during a utility failure. The generator located near the Llew Lawrence OMF Utility Complex may be installed outside in a weatherproof enclosure, on a concrete pad. The generator fuel tank may be located on the exterior as part of the generator package. If located outside, the generator must be screened and be visually cohesive with the Utility Complex. The generator must supply two 400 A, 600 V, 4P auto transfer switches, one for fire pump and one for the life safety devices.

B. A 400 A, 600 V manual transfer switch completed with a CAMLOCK receptacle shall be provided for the Llew Lawrence OMF to connect a mobile generator in the event of primary generator failure. This generator is only for life safety devices; the fire alarm pump is excluded.

C. A CAMLOCK for a load bank connection must be provided for the generator.

7-3.6.3 Power Distribution System

A. Electrical distribution panels must be installed in the electrical room and throughout the building, including column/wall/unistrut mounted electrical panels with their associated step-down transformers as required. 120 V, 15/20 A single phase general convenience duplex receptacles must be provided throughout the building. In general, receptacles will be column mounted. GFI, weatherproof and vandal proof receptacles will be installed outside of the building. Wall/Column mounted 600/347 V, 60 A welding receptacles will be provided where required. Power feeds and local disconnect switches will be provided for all mechanical equipment. Ceiling mounted junction boxes will provide power to heat tracing cables on the roof for drains and in the areas prone to freezing. Heat tracing control panel will be installed in the electrical room and will be monitored by the BMS.

B. A power factor correction system shall be installed on the 600 V switchboard to maintain the overall system power factors between 92% and 98%.

C. Inclusion of EV charging stations may be beneficial for purposes of LEED calculations as set out in Section 7-2.3 [*Sustainable Buildings and Infrastructure Rating Systems*] of this Schedule.

D. Ten parking stalls with EV charging stations (208 V/80 A) for ETS fleet vehicles must be provided. Each station must have communication conduits running from the closest MNAR inside the Llew Lawrence OMF to the station.

E. Provide block heaters receptacles (120 V/20 A) for all parking stalls.

F. The Design-Builder must Design and provide the power connection and requirements for all the mechanical and industrial equipment. Provide step down transformer as needed to accommodate the voltage level of the equipment. The Design-Builder must Design the feeders and branches to meet the voltage drop requirements based on CEC.

G. 600 V, three phase power must be provided for the HVAC units and other 600 V equipment located on the roof. Maintenance power outlets must be installed on the roof as per code requirements.

H. The Design-Builder shall provide information metering for each panel board and distribution switchboard.

I. The Design-Builder shall provide surge protective devices for main 600 V switchboards.

J. All breakers including and above 250 A shall be complete with an electronic trip unit.

K. All distribution panels shall include 20% spare bus capacity for future use in addition to requirements stipulated in Section 11.2.4.3 of the HFDG.

7-3.6.4 Design Consideration

7-3.6.4.1 Mechanical Equipment Electrical Panels

A. The Design-Builder shall provide and install the electrical equipment serving the mechanical equipment in the mechanical room, in a space inside the mechanical room. For mechanical loads outside of mechanical rooms dedicated panels are permitted to be in strategic areas to reduce feeder lengths.

7-3.6.4.2 Arc Flash and Incident Energy Study

A. The Arc flash study shall be based on CSA Z462 latest adopted edition.

B. The Arc flash labels shall be prepared and reviewed by the City before mounting on the electrical equipment.

C. All panels that have an incident energy of greater than 12 cal/cm^2 shall be reviewed with the building owner representative to confirm additional PPE is consistent with proposed operations of maintenance staff. If operations are compromised the Design-Builder shall provide options to reduce incident energy.

7-3.6.4.3 Lightning/Surge Analysis

A. A lightning/surge analysis must be performed to the requirements set forth in Section 11.2.5.4 of the HFDG. If required, further Design drawings must be prepared in accordance with the standard.

B. Provide a lightning protection grounding loop around the building and tie the lightning grounding loop to the building grounding loop.

7-3.6.5 Identification

7-3.6.5.1 Colour Coding of Systems Elements

A. The colour coding shall be in consistent with the HFDG Section 11.3.2.1.

7-3.6.5.2 Identification Labelling

A. The identification labelling shall be in consistent with the HFDG Section 11.3.2.2.

7-3.6.5.3 Wire and Conduit Identification Materials

A. The wire and conduit identification materials shall be in consistent with the HFDG Sections 11.3.2.3 and 11.3.2.4.

7-3.6.5.4 Colour Coding of Conductors

A. The colour coding of conductors shall be in consistent with the HFDG Sections 11.3.2.3 and 11.3.2.4.

7-3.6.6 Permanent Emergency Generator

A. An emergency generator must be provided that complies with the latest CSA-C282 standard for emergency electrical power supply in Llew Lawrence OMF. The generator must be diesel fueled; natural gas generators are not acceptable.

B. The generator sub-base fuel tank must be sized for the generator to run for at least 24 hours without refueling.

C. The generator set must have annunciator panel.

D. The generator set must connect to the fire alarm control panel.

7-3.6.7 Fire Alarm System

A. Refer to Section 11.7 of the HFDG for requirements of the fire alarm system as well as requirements set forth in this section.

B. A single stage, addressable fire alarm system panel at the electrical room must monitor the fire alarm devices installed throughout the building. A remote annunciator completes with a panel indicating fire alarm zones and system status must be located within the administrative area of the building at the designated street address entrance to the facility complete with a panel indicating fire alarm zones and system status. Fire alarm circuits must be Designed as Class B for the notification circuits and Class A for initiation circuits. Fire alarm system must be ULC rated for emergency evacuation. Pull stations shall be provided as per NBCAE requirements.

C. The building must be equipped with heat and smoke detectors as required by the NBCAE with horns and strobes for notification, providing the required sound level for evacuation. In addition to NBCAE requirements, smoke detectors must be provided in all electrical, mechanical and communication rooms.

D. The sprinkler system must be monitored and supervised by the fire alarm system.

E. The fire pump must be powered via an individual ATS according to CEC C22.1 latest adopted edition.

F. The fire alarm panel shall interface with the public address system in the building so that the system can be overridden in the event of a fire alarm.

G. The emergency generators shall be interfaced to the fire alarm system to provide generator status and trouble signals to the fire alarm panel and shall be shown on the fire alarm annunciator panel.

H. The fire alarm panel shall have its monitoring signal sent via BMS to the LRT Operations and Control Centre at Churchill Station which is monitored 24/7.

I. The monitoring in section H above is separate from the required monitoring of the fire alarm from a ULC listed fire alarm monitoring agency via phone/gsm connection.

7-3.6.8 Lighting

A. LED lighting should be used for all lighting Designs.

B. The Illumination Level shall be in consistent with the HFDG Section 11.8.4. Additional illumination levels are listed in the table below:

Table 7-3.6.8: Illumination Levels for the Llew Lawrence OMF

Location	Average Minimum (Lux)
Perimeter Fence	5
Vehicle Entrances	100
Yards	10
LRV Storage Areas	25
Track Switch Areas	40
Shop Areas	550
Roof Access Platforms	550
Pits	1100
Shop Storage Areas	270
Office Areas (Ambient with Additional Task Lighting)	270
Maintenance Areas	1100
Open Trackway	10
LRT ROW Equipment areas	20
Parking Areas	10

7-3.6.8.2 Lighting Control

A. Lighting controls arrangement, programming and layouts must incorporate building's operational requirements and best sustainability practices. Lighting control system components must be interfaced with the BMS.

B. Low voltage lighting controls must be operated by a simple relay-based system.

C. Low voltage lighting controls must be monitored and controlled by the BMS.

D. NECB Part 4 for lighting must be followed for switching arrangements. The Design-Builder must coordinate the switching arrangements with the facility users through the City to confirm that the appropriate controls are being specified in accordance with NECB.

E. Exterior luminaries, including luminaries in signage, must be controlled by photocells and the BMS.

F. Exterior light control must include a maintenance bypass switch (Hand-Off Auto).

7-3.6.9 Emergency Lighting

A. Emergency lights must be fed via the emergency generator circuits providing illumination levels complying with the NBCAE to provide safe egress from the Llew Lawrence OMF. The generator must be CSA 282 compliant with a separate ATS for life safety equipment.

B. Emergency egress lighting systems must be provided as required by code. Regardless of the power supply sources available, electrical rooms and generator rooms must be equipped with a minimum of one self-contained battery pack with light heads.

7-3.6.10 Grounding and bonding system

The grounding and bonding shall be in consistent with the HFDG Section 11.10.

7-3.6.11 Duct Banks

A. The Design-Builder must provide separate conduit and pull boxes for power and communication cables.

B. The Design-Builder shall provide a duct bank for the communication cable from the Utility Complex to the MNAR in Llew Lawrence OMF. The communication duct bank shall be in consistent with the HFDG Section 11.11.2.

C. The Design-Builder shall provide a duct bank for the emergency power cable from the generator set close to the Utility Complex to the emergency electrical room in Llew Lawrence OMF. The power duct bank shall be in consistent with the HFDG Section 11.11.1.

D. The duct bank design and installation shall be consistent with the HFDG Section 11.11.

7-3.6.12 Solar System

A. The Design-Builder must provide required spaces for the future solar panel installation and termination on the roof of Llew Lawrence OMF. The Design shall meet City of Edmonton Solar Photovoltaic Program, Version 2.0, Design Guideline, COE-IM-GUIDE-0004. The main circuit breaker for the solar system shall be Designed at the supply side of one of the unit substations.

7-3.7 COMMUNICATIONS INFRASTRUCTURE

A. The Design-Builder must Design and Construct the CTS for the Llew Lawrence OMF integrated with the CTS from the extension and the Capital Line LRT.

B. The ETS communication room is to be supplied with power from a dedicated UPS that is to be installed in the electrical room of the Llew Lawrence OMF building, as stipulated in Appendix 6E Section 2.3.1 [*Communications Power System*] of Part 6.

C. The CTS used in the Llew Lawrence OMF must be similar and compatible with the Capital Line LRT equipment and Corporate IT Network equipment.

D. Any deviation proposed by the Design-Builder from the Approved Products List, provided as Disclosed Data, must be reviewed and approved by the City.

E. The CTS for the Llew Lawrence OMF must be divided into two different systems:

1. A CTS dedicated to the LRT operations, ETS Network; as described in Section 6-4 [*Communications*] of this Schedule, the networking equipment required for the ETS Network must be located in the Llew Lawrence OMF building ETS Network communications room.

2. A CTS, connected to the Corporate IT Network, providing services for Wi-Fi and facility BMS, in the Llew Lawrence OMF building, the networking equipment required for the Corporate IT

Network must be located in the Llew Lawrence OMF building Main Network Access Room (MNAR).

F. As defined in the HFDG Section 12.8.1.2 – "Facility Network", the BMS is comprised of two different individual BMS and the Design-Builder must provide it to the Llew Lawrence OMF:

1. BMS for facility management services; this BMS must be located inside the Llew Lawrence OMF and be connected to the Corporate IT Network, serving all building facility equipment including: HVAC, local control panels, fire alarm and any other alarm (if applicable).

2. BMS for ETS Network; this BMS will be located in the Llew Lawrence OMF communications room and include a connection to the facility BMS for fire and generator alarms at the Llew Lawrence OMF. It will control all ETS equipment in the Llew Lawrence OMF.

7-3.7.1 ETS Network

A. The Design-Builder must Design and Construct the ETS Network to support LRT operations in the Llew Lawrence OMF. This system must be part of the extension of the ETS network described in Section 6-4 [*Communications*] of this Schedule.

B. The ETS communication room is to be fed from dedicated UPS located in the Llew Lawrence OMF electrical room.

C. The extension of the ETS Network, must comply with the HFDG Section 8 – "Communications" and the communications design preliminary report in Appendix 6E [*Communications Design Preliminary Report*] of Part 6.

D. Network architectures and rack layouts that the Design-Builder must base its design on are described in the communications design preliminary report given in Appendix 6E [*Communications Design Preliminary Report*] of Part 6.

E. The ETS Network inside the Llew Lawrence OMF should cover the following services, but not limited to: CCTV, access control system, Public Address, ETS Network BMS, telephone system, data outlet, intrusion detection.

7-3.7.1.1 CCTV Security and Intrusion Detection

A. The CCTV system must comply with the requirements given in the HFDG Section 8.6 – "Closed Circuit Television".

B. The CCTV system and intrusion detection must follow the requirements given in the communications design preliminary report in Appendix 6E [*Communications Design Preliminary Report*] of Part 6.

C. The Design-Builder must Design and Construct Site security measures for the Llew Lawrence OMF to provide:

1. CCTV coverage of the Yard Tracks;

2. CCTV coverage and intrusion detection at the main gate and fence openings between the mainline and the yard; and

3. CCTV coverage of the Llew Lawrence OMF building.

7-3.7.1.2 Access Control and Telephone for Security Gates

A. The security gates of the Llew Lawrence OMF must be provided with:

1. C-cure access card, following the requirements in Section 2.6 of Appendix 6E [*Communications Design Preliminary Report*] of Part 6; and

2. Telephone besides the access card, connected directly to the OCC via VOIP, following the requirements in Section 2.11 of Appendix 6E [*Communications Design Preliminary Report*] of Part 6.

7-3.7.1.3 Duct Banks

A. The Design-Builder must Design and Construct the communications duct banks within the Llew Lawrence OMF following the requirements given in Section 6-1.2 [*Duct Banks*] of this Schedule.

B. The Design-Builder must Design and Construct the duct banks for the Ultimate Buildout. No additional duct banks may be added in future expansion. The duct banks must be sized to accommodate future expansion.

C. The Design-Builder must Design and Construct a duct bank from the Llew Lawrence OMF Utility Complex communications room to the Llew Lawrence OMF building to connect the ETS Network communications room and the Corporate IT MNAR.

D. The Design-Builder must Design and Construct a duct bank from the Llew Lawrence OMF Utility Complex communications room to the future administrative building. The duct bank should be at least composed of four 103 mm ducts.

E. The duct bank must be able to accommodate cabling for the following systems and facilities:

   1. ETS Network:

      a. Digital electricity structured cables

      b. Single mode fibre optic data cables

      c. Copper cables

      d. Cat 6 PoE cables

   2. The Corporate IT Network CTS:

      a. Single mode fibre optic data cables

      b. Copper cables

      c. Cat 6 PoE cables

   3. Spare (25% per type), provide 25% spare space in each conduit.

7-3.7.1.4 Cabling

A. The Design-Builder must provide a fibre connection between the Llew Lawrence OMF Utility Complex communications room to the Llew Lawrence OMF for Corporate IT Network communications. The fibre must be 48 strands single mode fibre optic cable and be terminated in the MNAR.

B. The Design-Builder must provide a fibre connection between the Llew Lawrence OMF Utility Complex communications room to the Llew Lawrence OMF for ETS Network communications. The fibre must be 144 strands single mode fibre optic cable and be terminated in the ETS communication room.

C. When located in the yard, the end-devices must be connected to the Llew Lawrence OMF building ETS communications room. Cat 6 cabling must be used if the end-device is closer than 90 m from the

ETS communications room. Otherwise, powered fibre must be used. A media converter may be needed if the end-device is only capable of PoE.

7-3.7.2 Information, Communications Technology, Security (ICTS)

A. ICTS Design and Construction Responsibility

1. A summary of responsibilities for communications Design and Construction is indicated below:

   a. the Design-Builder must provide infrastructure, cabling, pathway, and power, including design, installation, testing and commissioning, for horizontal and backbone structured cabling.

   b. the Design-Builder must provide infrastructure, cabling, pathway, and power for the MNAR, including design, installation, testing and commissioning. All active equipment must be provided by the Design-Builder including design, installation, testing, commissioning, connecting, programming and configuration unless specifically indicated in Table 1-1.3.1 [*City Works*] of Part 1 [*General*].

   c. the Design-Builder must provide infrastructure cabling, pathway, and power for internal wireless access, including design, installation, testing and commissioning. All active components will be provided including design, testing, commissioning, programming and configuration by the City. The wireless access points must be installed and connected by the Design-Builder in coordination with the City.

   d. the Design-Builder must provide infrastructure, cabling, pathway and power as required for Corporate IT Network (Open City and Technology) including design, installation, testing, commissioning, programming and configuration. All active equipment will be provided, including design, install, testing, commissioning, programming and configuration by the City. The Design-Builder must coordinate with the City to provide space in the equipment rack and the MNAR.

   e. the Design-Builder in coordination with the City must provide infrastructure, cabling, pathway and power as required for Corporate IT Network, including design, installation, testing, commissioning, programming.

   f. where copper data cables runs exceed 90 m from the MNAR, the Design-Builder must provide in coordination and approval from the owner additional NAR, where required, complete with accessories, power source, fiber cable and infrastructure in compliance with TIA/EIA standards and connect to the MNAR equipment racks.

   g. the Design-Builder must build a NAR on each additional floor. The NAR must comply with the same requirements as the MNAR and must be powered from the same source, refer to Edmonton Facility Consultant Manual, Sections 2.5 and 2.6.

   h. where data cable runs exceed 90m from the ETS Communication Room, the Design-Builder must provide in coordination and approval from the owner, media converters where required, complete with accessories, power source and fiber cable and infrastructure in compliance with TIA/EIA standards and connect to the ETS Communication Room. If the media converters are located outdoors, they must be provided in a weatherproof housing.

2. The Design-Builder must Design and provide all CTS and equipment, integration, interfacing, performance, and quality requirements as described in Edmonton Facility Consultant Manual.

B. Corporate IT Network in Llew Lawrence OMF.

1. General Requirements

a. The Design-Builder must provide an extension to Corporate IT Network within the Llew Lawrence OMF.

b. The Corporate IT Network may be referred to as Open City & Technology Network in the Edmonton Facility Consultant Manual.

c. The extension of the Corporate IT Network must be fault tolerant, at a minimum, to the same degree as the administrative data network provided by the existing Corporate IT Network.

2. The Design-Builder must provide extension of the Corporate IT Network in-coordination with the City:

a. the Design-Builder must provide cables, wiring, raceways, cable trays, conduits, sleeves equipment racks and UPS;

b. the Design-Builder must provide electrical requirements as required;

c. the Design-Builder must refer to Schedule 4 Appendix 4D [*Project Specific Submission Requirements*] and the Edmonton Facility Consultant Manual for submission requirements;

d. the supply of equipment, design and configuration of the Corporate IT Network will be completed by the City;

e. Design-Builder must install Corporate IT Network extension equipment provided by the City.

C. Corporate IT Network in Llew Lawrence OMF Fibre Optic Cabling

1. The Design-Builder must provide fibre optic cabling in accordance with the Edmonton Facility Consultant Manual.

2. The Design-Builder must carry out a PICO plan that includes, at a minimum:

a. cable tests including insulation, continuity and OTDR tests of terminated cables;

b. cable termination and interconnection verifications; and

c. verification of termination markings and labels.

D. Wi-Fi (Internal Wireless Access)

1. The City will:

a. procure, configure, wireless LAN Wi-Fi controllers to support the wireless network within the Llew Lawrence OMF.

b. procure, program, and configure wireless access points and provide to Design-Builder for installation.

2. The Design-Builder must:

a. consult with the City network analyst to determine the Wi-Fi requirements;

b. coordinate with the City network analyst to generate heat maps. Provide floor plans to the network analyst obtain all information of the heat maps for the facility indicating the channel coverage, signal strength, data rate capacity and noise floor for the 802.11 ac/n wireless network for approval by the City;

c. install all structured cabling;

d. provide a complete structured cabling and pathway infrastructure that will allow the installation of the complete Wi-Fi network, including PoE wireless access points;

e. install data outlets and access points in consultation with the City;

f. provide each wireless access point with one data drop terminated at a telecommunication outlet; and

g. install wireless access point at the columns or bottom chord of the joists throughout the Llew Lawrence OMF to facilitate wireless communication as per heat map provided by the City.

E. Main Network Access Room

1. The MNAR must:

   a. not be located on exterior walls;

   b. include sufficient wall space and equipment racks to support all CTS;

   c. include two additional racks for future expansion (complete with vertical cable managers, PDU and power receptacles); and

   d. be 2-hour fire rated.

2. MNAR must be located away from water infiltration per Clause 6.3.8 of the ANSI/TIA-569-C standards for communications rooms.

3. The Design-Builder must provide one MNAR in Llew Lawrence OMF to accommodate the telecommunications infrastructure and equipment.

4. The Design-Builder must provide conduit from the communication room located in the Utility Complex to the MNAR located in the Llew Lawrence OMF.

F. Equipment Racks

1. Equipment racks installed in the MNAR must include, but are not limited to, network racks, and fibre termination racks. Each rack must include 20% spare capacity for future growth.

2. Network racks must meet the requirements of the Edmonton Facility Consultant Manual.

3. The Design-Builder must coordinate with the City, to determine exact PDU receptacle types required prior to procurement. Each PDU must have sufficient receptacles to support the equipment within the racks and 20% spare and must comply with the Edmonton Facility Consultant Manual.

4. The Design-Builder must carry out load study and provide UPS system in the MNAR for Llew Lawrence OMF as required per Edmonton Facility Consultant Manual.

5. The Design-Builder must provide 1 m clearance on the front, back and to one side of each rack or rows of racks. The 1 m clearance will be measured from the vertical cable managers or the farthest protruding rack mounted equipment (into room) to farthest protruding wall mounted equipment (into room).

6. A ground bar system must be provided with the rack for chassis ground, a ground-collection point that connects to the metal enclosure of an electrical device.

7. Static ground straps must be installed inside, in the front or rear of the cabinet for the handling of static sensitive cards.

8. The equipment rack standard of acceptance is Panduit, or other approved by the City.

G. Structured Cabling

1. The structured cabling system must be Designed, installed, and tested by the Design-Builder.

2. Structured cabling standard of acceptance is Panduit, or other approved by the City.

3. Horizontal structured cabling must be of the Cat 6 type where category cable is required.

4. Cat 6 cable runs must be less than 90 m long and continuous from jack-to-jack.

5. The cabling infrastructure must be universal and support all networks, systems, and equipment requiring network connections in the. Llew Lawrence OMF.

6. The Design-Builder must provide preliminary conceptual drawings of proposed telecommunications outlet locations to the City for review and approval.

7. The Design-Builder must create, in consultation with the City, a plan for cable infrastructure management and resource requirements for maintenance.

H. Telecommunication Outlets and Data Drops

1. Notwithstanding any standards referenced in this Schedule, all data outlets, data drops, communications outlets or telecommunication outlets included in the Llew Lawrence OMF must:

   a. comprise of a complete Cat 6 structured cabling connection between an RJ45 outlet jack and network switch port (including Cat 6 patch cord);

   b. include a 4-port cover plate for jack terminations, two for the Corporate IT Network and two for the ETS Network, with labelling to match existing City facilities and filler plates on unused outlets. Cover plates must always have at least one unused jack termination space.

2. The Design-Builder must:

   a. include all raceways and supports including, but not limited to, minimum 27 mm EMT conduits and cable tray raceways;

   b. provide a minimum of two data drops at each data outlet location; and follow all manufacturers recommendations for terminating and installation of data cabling, including bend radius limits;

   c. terminate all horizontal cables on Cat 6 patch panels located in the closest MNAR, NAR or ETS communication room;

   d. Design each room in the Llew Lawrence OMF such that data drops are distributed throughout each room as required to support operational functionality and convenient use of all equipment requiring data drops by Llew Lawrence OMF users;

   e. provide data ports in the wall for each workstation fed via base feed or power pole with the cable run within the furniture system;

   f. provide data ports in the furniture fed by power poles provided with the furniture system with the data c able run to the patch panels in the equipment rack and terminated;

g. coordinate with industrial and provide data ports in the main level and pit level;

h. co-locate, at each telecommunications outlet location, one duplex receptacle. Additional receptacles must be provided where required for end-use equipment. Wireless access points outlet locations are exempt from being provided with a duplex receptacle;

i. coordinate with the City and provide conduit to the EV charging stations in the Llew Lawrence OMF, from the nearest MNAR to run cable in the future.

I. Communications Raceway

1. The Design-Builder must provide a complete raceway infrastructure system for the cabling required for all systems as per Edmonton Facility Consultant Manual.

2. Cabling must be enclosed in cable tray, rigid electrical metallic tubing, or electrical metallic tubing outside of MNARs.

3. Where cabling is required to penetrate through fire rated walls it must do so without derating the fire rating of the wall and without the requirement for additional equipment and/or materials.

4. The Design-Builder must provide cable tray in all corridors to support all cabling filled to a calculated maximum of 25%.

5. The Design-Builder must provide cable tray in MNAR to minimize the cable drop distance from the cable tray to each equipment rack and wall mounted equipment.

6. Conduit runs to data outlets must be 27 mm minimum.

7. The Design-Builder must provide a separate dedicated raceway in MNAR to support fibre optic cabling and ensure this raceway must be installed to minimize fibre optic cable drop distances.

8. The Design-Builder must protect and store excess fibre optic cabling inside MNAR using fibre storage rings or approved equal.

9. When cabling transitions in and out of a cable tray, transition devices must be provided (i.e. waterfalls).

10. All cable trays must be easily accessible for future cabling installation and away from sources of EMI, hot water pipes, and other obstructions.

11. Pull boxes may be used only for straight pulls.

12. The Design-Builder must paint all junction, pull boxes and conduits at regular intervals in consultation with the City to easily identify the system they correspond to.

13. The Design-Builder must ensure all conduits are free of sharp edges that could damage the cabling. All conduits must be provided with bushings.

14. The Design-Builder must ensure that power and data routing is planned for all offices and workstations. Workstations must require ceiling fed power and data.

15. The Design-Builder must provide grounding/bonding bushing to conform to ANSI/TIA-607-C.

7-3.8 WATER, WASTEWATER AND STORMWATER MANAGEMENT

A. Yard

1. The Design-Builder must provide accessible hydrants for fire protection of the Llew Lawrence OMF yard and Yard Track areas. Hydrants must be located such that a fire in any area of the yard can be attacked using the hose length recommended by the Authority Having Jurisdiction.

B. Llew Lawrence OMF Water and Wastewater Servicing.

1. The Design-Builder must ensure that all proposed water services comply with the D&CS Volume 4: Water.

2. A minimum of 30 days prior to the applicable first Interim Design submission, the Design-Builder must submit a water servicing design and Hydraulic Network Analysis (HNA) report that reflects actual Site Design conditions. Refer to the D&CS for more information. The servicing study information provided in “Water and Sanitary Servicing Report, Capital Line South Extension (Century Park to Ellerslie Road) Owner’s Engineer” prepared for the City in March 2023 is available as Disclosed Data. The Design-Builder shall be responsible for verifying the information in the above-mentioned servicing report is still relevant for the Llew Lawrence OMF Stage 1 and Ultimate Buildout. The servicing strategy shall consider the potable water requirements for all uses including wash bay facilities and fire flows.

3. The Design-Builder must make application and payment to EPCOR Water Services Inc. for the water service connection and adhere to EPCOR Water and Sewer Connections Guidelines.

4. The off-site water infrastructure Design and Construction must meet the requirements of the D&CS to the satisfaction of EPCOR Water Services Inc. The Design-Builder must contact EPCOR Water to discuss Design requirements, obtain boundary hydraulic grade line information and potential areas of connection (e.g. water main connection at Ellerslie Road and 127 Street SW).

5. If multiple water services are required for the Llew Lawrence OMF or other parts of the proposed development area, check valves must be required where a looped system is created (refer to D&CS Volume 4).

6. The Design-Builder must ensure that all proposed sanitary sewers and services comply with the D&CS Volume 3: Drainage except that the sanitary pump station may be a prefabricated, modular, in-ground system that incorporates all required control and monitoring functions.

7. A minimum of 30 days prior to the applicable first Interim Design submission, the Design-Builder must submit a wastewater servicing design report that reflects actual Site Design conditions. The servicing study may use the information provided in “Water and Sanitary Servicing Report, Capital Line South Extension (Century Park to Ellerslie Road) Owner’s Engineer” prepared for the City of Edmonton in March 2023 for reference. The Design-Builder shall be responsible for verifying the information in the above-mentioned servicing report is still relevant for the Llew Lawrence OMF Stage 1 and Ultimate Buildout. The servicing strategy must include all wastewater flows generated by the Llew Lawrence OMF, including those generated from the LRV wash bay facilities.

8. The Design-Builder must make application and payment to EPCOR Water Services Inc. (Drainage Services) for the wastewater service connection and adhere to EPCOR Water and Sewer Connections Guidelines.

9. EPCOR Water Services Inc. (Drainage Services) must be consulted during the Design of the proposed sanitary sewers outside the Llew Lawrence OMF boundary.

10. If any new sanitary sewer is proposed on 127 Street SW to service the Llew Lawrence OMF, it must also have capacity to convey sewage from the proposed TOD developments in the area.

C. Llew Lawrence OMF Stormwater Servicing

1. The Design-Builder must ensure that all proposed stormwater servicing complies with HFDG and Section 3-3 [*Stormwater Management*] of this Schedule.

2. The Design-Builder must provide a minor and major storm drainage system such that all storm water within the Llew Lawrence OMF and track areas discharges to the expanded Heritage Valley Park and Ride SWMF.

3. Refer to Section 3-3.4 [*Llew Lawrence OMF and Heritage Valley Park and Ride SWMF*] for the requirements related to the expansion of the existing Heritage Valley Park and Ride SMWF.

4. The minor system must be sized for the 1:5 year rainfall event, and the major system must convey runoff in excess of the 1:5 year event.

5. Sub-drain systems with cleanouts and backflow preventers must be provided for the tie and ballast track areas and may tie into the minor drainage system. Sub-drain systems must comply with the HFDG Section 16.4.4.1 – "Tie and Ballast Track Drainage".

6. Sub-drain system must be sized for the 1:25 year rainfall event. If the sub-drain system ties into a minor system, the minor system must be sized to ensure that sub-drain system does not get surcharged in a 1:25 year rainfall event.

D. Stage 1 Considerations

1. All storm, sanitary, and water services must be sized for the Ultimate Buildout of the Llew Lawrence OMF as Ultimate Buildout will require maximum capacity. Invert elevations of all the proposed buried onsite and offsite storm and sanitary sewers including sub-drain pipes must work for both Stage 1 and Ultimate Buildout. The following items may differ in between Stage 1 and Ultimate Buildout:

   a. Sanitary and water service tie-in locations.

   b. Stormwater roof drain tie-in locations.

   c. Additional sub-drain systems will be required for the Ultimate Buildout.

7-3.9 CIVIL

A. Site Access

1. The Design-Builder must provide a Roadway including Emergency Services access within the Llew Lawrence OMF Site.

   a. Duct banks should be located directly below the Roadway to minimize the number and impact of underground crossings.

2. The Design-Builder must provide sidewalks from parking facilities to building entrances within Llew Lawrence OMF.

3. The Design-Builder must provide a two-way Roadway and pedestrian access from 127 Street SW, in accordance with Section 3-2.4.3.2 [*127 Street SW (Ellerslie Road to Llew Lawrence OMF Access)*], to the Llew Lawrence OMF.

   a. Pedestrian access may connect from Heritage Valley Transit Centre SW to the Llew Lawrence OMF

4. The Design-Builder must provide road access to the Llew Lawrence OMF yard to accommodate large delivery vehicles (WB-21), Emergency Services vehicles, and waste collection equipment.

5. The Design-Builder must provide access and turnaround capability for:

    a. WB-21 vehicles engaged in delivery at loading docks and waste collection at designated areas;

    b. large ROW road running vehicles (SU-9) at ROW storage and maintenance, if provided;

    c. large maintenance and repair vehicles (SU-9) at Llew Lawrence Utility Complex, as may be required to demonstrate compliance with Appendix 5-1B [*High Floor Operations and Maintenance Parameters*]; and

    d. large maintenance and repair vehicles (SU-9) at Anthony Henday TPSS, as may be required to demonstrate compliance with Appendix 5-1B [*High Floor Operations and Maintenance Parameters*].

6. The Design-Builder must provide sufficient clearances to ensure waste collection operations do not interfere with normal activities anticipated by Appendix 5-1B [*High Floor Operations and Maintenance Parameters*]. The waste bins (not provided by the Design-Builder) expected for waste collection are:

    a. Types of containers:

        i. Garbage: slant bin

        ii. Recycling: slant bin

        iii. Organics: slant bin

        iv. Woodbin: large bin

    b. Size and number of containers:

        i. Garbage: 2 bins (4-6 cu.yd.)

        ii. Recycling: 2 bins (4-6 cu.yd.)

        iii. Organics: 1 bin (4-6 cu.yd.)

        iv. Woodbin: 1 bin (20 cu.yd.)

    c. No compactor is required.

    d. No staging area is required internally. Small bins throughout the shop will be collected by cleaning staff and dumped into the outside bins.

7. The Design-Builder must Design and Construct Site security measures for the Llew Lawrence OMF to provide:

    a. protection of stored LRVs and the Building Structure against intruders and vandalism;

    b. fencing and gate material and construction is in accordance with Section 2-10.14 [*Fencing*] of this Schedule;

    c. continuous and permanent fencing enclosing the Llew Lawrence OMF such that the east boundary of the fencing encompasses:

i. Llew Lawrence OMF

ii. those sections of Llew Lawrence OMF that are used for the purposes described in Section 7-1.1 [*General Requirements*] of this Schedule.

8. The Design-Builder must Design and Construct employee platforms for the northbound and southbound mainline tracks generally in the location shown in Appendix 5-7C [*Llew Lawrence OMF General Track Layout*], and must include:

a. a platform structure allowing level boarding into LRVs with stairs, handrails, electrical, lighting, security, and call button activated by card reader, all generally in accordance with the North East Transit Garage (Kathleen Andrews) LRT Platform Drawings included in Disclosed Data, oriented such that:

i. five coupled LRV's stopped for access or egress at the northbound employee platform must not block employee access to the southbound employee platform;

b. Safety railings, generally in accordance with the employee platform shelter design included in Disclosed Data, oriented such that:

i. employees must be able to visually look both ways down the Trackway, without obstruction, prior to crossing an At-Grade track crossing; and

ii. employees must be prevented from inadvertently walking onto the Trackway.

c. An employee shelter, with electrical lighting, security, and call button, generally in accordance with the employee platform shelter design included in Disclosed Data, oriented such that:

i. employees will be sheltered from prevailing wind and precipitation;

ii. employee shelter will be constructed east of the northbound track; and

iii. call button, activated by card reader, will illuminate the luminaire on the appropriate platform.

d. A direct 2.0 m hard surfaced walkway connection, from the employee platforms to the southwest face of the Llew Lawrence OMF, with all track crossing in accordance with Section 7-3.10.G [*Road/Pedestrian At-Grade Crossings*] of this Schedule.

B. Parking Facilities

1. The Design-Builder must provide parking facilities as required to meet the overall parking requirements for the Llew Lawrence OMF.

2. The DBA governs over the Zoning Bylaw for the purpose of vehicle and bicycle parking requirements.

3. At a minimum, the Design-Builder must provide:

a. 130 parking stalls including five barrier-free stalls, and five visitor parking stalls for the Llew Lawrence OMF:

i. inclusion of EV charging may be beneficial for purposes of LEED calculations as set out in Section 7-2.3 [*Sustainable Buildings and Infrastructure Rating Systems*] of this Schedule.

ii. Inclusive of eleven oversized vehicle parking stalls, sizing defined by City of Edmonton Zoning Bylaw 12800, to be located near the truck loading dock of the Llew Lawrence OMF:

iii. ten of the oversized vehicle parking stalls must allow for EV charging. Refer to Section 7-3.6 [*Electrical*] of this Schedule for power distribution requirements.

b. the number of Barrier-Free employee parking stalls required by the NBCAE, to be located adjacent to entrances of the Llew Lawrence OMF;

c. six outdoor bicycle parking spaces, in the form of racks, with no less than six to be located adjacent to the Llew Lawrence OMF; and

d. six indoor bicycle parking spaces in a secure indoor enclosure.

C. Design Requirements

1. The Site preparation, base preparation, and granular material required within the Llew Lawrence OMF conforms to the D&CS Volume 2.

2. Lot grading must conform to City of Edmonton Drainage Bylaw 18093.

3. The access roads and parking lot conforms to the D&CS Volume 2:

a. parking stalls must be delineated by line paint conforming to the D&CS, Access Design Guide, and TAC Manual of Uniform Traffic Control Devices for Canada;

b. curbs or curb stops must be provided for each parking stall;

c. compacted gravel, conforming to the D&CS Volume 2, creating a surface that can be driven on and/or used as outdoor storage must be constructed on top of subgrade in the Llew Lawrence OMF Site with the exception of:

i. Stage 1 building footprint

ii. Track extents

iii. Access roads, concrete pads, sidewalks, parking areas

iv. Landscape and SUI requirements

4. The Design-Builder must install height clearance guard for vehicles entering the Llew Lawrence OMF Site for clearance check of OCS height.

5. The Llew Lawrence OMF Site must account for any drainage requirements to mitigate flooding and/or ponding as defined in Section 7-3.8 [*Water, Wastewater and Stormwater Management*].

7-3.10 TRACK

A. The Design-Builder must Design and Construct all Llew Lawrence OMF track generally in accordance with the configuration shown in Appendix 5-7C [*Llew Lawrence OMF General Track Layout*] and including the following requirements.

1. Modifications to the reference track alignment and profile are permitted, unless otherwise prescribed.

2. All Stage 1 track Design and Construction must consider the general track configuration shown in the Drawing 03-CT-9355 of the Reference Design provided as Disclosed Data for the Ultimate Buildout track requirements. The Design-Builder must demonstrate the Ultimate Buildout track layout plan does not require realignment of Stage 1 tracks.

3. The Design-Builder must Design and Construct all Llew Lawrence OMF track as set out in Section 7-3.10H [*Design Requirements*] that including the following track elements:

    a. Lead Tracks

        i. North Lead Track

        ii. South Lead Track

        iii. Wye track

    b. Yard Tracks and Shop Tracks

        i. Runaround track

        ii. LRV storage tracks

        iii. Service line/wash tracks

        iv. ROW equipment tracks

        v. Maintenance tracks

        vi. Ballast loading track

        vii. Turntables and connecting tracks in the ROW of the Llew Lawrence OMF

    c. Emergency tracks

B. The Design-Builder must also conform to the following requirements to Design and Construct the Llew Lawrence OMF:

1. Conform to the Design requirements as set out in Section 3-1 [*Track*] of this Schedule, otherwise adhere to Project specific Llew Lawrence OMF track Design requirements as set out in this Section.

2. Road access and At-Grade track crossing points as required by Emergency Services.

C. Tie and Ballast Track

1. The Design-Builder must provide tie and ballast track at the following locations:

    a. all Yard and Lead Tracks unless otherwise indicated in this Section;

b. outdoor LRV storage tracks in Stage 1.

D. Concrete Embedded Track

1. The Design-Builder must provide concrete Embedded Track at the following locations:

a. minimum 5 m wide apron outside of limit of north side of buildings;

b. minimum 10 m wide apron outside of limit of south side of buildings;

c. maintenance tracks unless otherwise designated as Pit Tracks in this Section;

d. service line/wash tracks unless otherwise designated as Pit Tracks in this Section

e. LRV storage tracks unless otherwise for outdoor LRV storage tracks in Stage 1; and

f. ROW equipment tracks.

E. Pit Track

1. The Design-Builder must provide Pit Track at the following locations:

a. maintenance tracks as indicated in this Schedule and generally with the facility and track layout in Appendix 5-7C [*Llew Lawrence OMF General Track Layout*];

b. service line track as indicated in this Schedule and generally with the facility and track layout in Appendix 5-7C [*Llew Lawrence OMF General Track Layout*].

F. Diamond Crossover

1. The Design-Builder must provide a concrete embedded diamond crossover at the following location:

a. a diamond crossover with No. 5 turnouts between the service line/wash tracks, W1 and W2.

G. Road/Pedestrian At-Grade Crossings

1. The Design-Builder must provide road and pedestrian At-Grade Crossings as per the HFDG Section 5.4.3 – “Pedestrian/Shared Use Crossings”.

2. Road Crossings

a. the Design-Builder must provide road crossings as set out in Section 3-1.1.4.4 [*Yard Crossings*] of this Schedule.

b. road crossings within OMF must be modular pre-cast concrete planks with rubber rail seals on hardwood ties.

3. Pedestrian Crossings

a. the Design-Builder must provide pedestrian crossings on mainline for access to the employee service platform, in addition to the walkways required within the yard.

b. Pedestrian crossings must be moulded rubber panels as per the HFDG Section 5.4.3 – “Pedestrian/Shared Use Crossings”.

H. Design Requirements

1. Design of the Llew Lawrence OMF yard must be based on the LRV fleet size and yard capacity requirements that demonstrate compliance with Appendix 5-1B [*High Floor Operations and Maintenance Parameters*].

2. The Design-Builder must construct at a minimum two Lead Track tie-ins to Mainline Tracks. Refer to Section 3-1.1.4.3 [*Connection to Mainline*] for mainline connection requirements.

3. Wye track must be connected to the runaround track and the north Lead Track.

4. All Yard Tracks must be connected, on both ends of the track, to a continuous runaround track that loops around the outer limit of the yard.

5. Allowable stub ended tracks are the ballast loading track, emergency tracks, ROW equipment tracks.

6. A tangent test track must be provided at the outer limit of the yard, outside of building where an LRV could reach speeds of 60 km/h. The test track must not cross At-Grade crossings.

7. LRV storage tracks requirements as set out in Section 7-3.2 [*Architectural*] for 90 units at Ultimate Buildout. Stage 1 storage consists of 30 units indoor and 20 units outdoor.

8. Stage 1 outdoor LRV storage tracks are tie and ballasted track and are to be converted to embedded LRV storage tracks at Ultimate Buildout.

9. LRV storage track S6 must be provided with OCS but non-energized and serves as temporary ROW equipment track in Stage 1.

10. Service line/wash tracks, ROW equipment tracks, and Maintenance tracks requirements as set out in Section 7-3.2 [*Architectural*] and 7-3.3 [*Industrial*] of this Schedule.

11. Minimum 10 m of tangent track must be provided outside the limit of buildings.

12. A minimum 30 m tangent stub ended ballast loading track must be provided within the yard for loading ballast onto track maintenance rail borne vehicles. No OCS is to be provided at the ballast loading track.

13. Stub ended emergency tracks with vehicle overrun protection as per Section 3-1.2.3.6.F [*Vehicle Overrun Protection*] to safeguard the Mainline Track from potential runaway vehicles and equipment must be provided prior to mainline tie-ins. The minimum length of the track must be 40 m from face of bumper to the fouling point.

14. Foldable or removable LRV stopping devices must be provided for the ROW equipment tracks and ballast loading track to prevent rail borne vehicles from moving off the stub ended tracks.

15. Not less than 90 Business Days after the Effective Date, The Design-Builder must prepare and submit a yard circulation report, that demonstrates the ability to:

    a. launch trains at required headways directly from storage without need of any reversing movements;

    b. receive trains at end of service without queuing on the Mainline Track;

    c. perform daily, light maintenance operations at required intervals;

    d. Ultimate Buildout to store 90 LRVs on-site on dedicated double ended LRV storage tracks;

e. transport LRVs directly to LRV storage tracks, without having to travel on any Maintenance tracks;

f. provide track redundancy so that yard circulation is not impeded by a single point failure which could trap LRVs within any portion of Llew Lawrence OMF; and

g. perform all movements between any storage, maintenance, or service line/wash track within Llew Lawrence OMF with a maximum of one reversing move.

16. The Design-Builder must Design and Construct the Llew Lawrence OMF Lead Tracks and Yard Tracks, in compliance with the Accepted Llew Lawrence OMF yard circulation report.

I. Project Specific Design Criteria

1. Where track geometry is constrained by non-movable elements, the following Llew Lawrence OMF Project specific Design criteria may be used. The Design-Builder must submit a Design brief to the City. The brief must clearly state where these criteria are applied and demonstrate reason to deviate from the requirements of the HFDG.

2. Horizontal Alignment

a. Tangent Between Curves

i. The minimum tangent length between curves for LRV storage, ROW equipment and Maintenance tracks may be 21 m.

b. Tangent at Special Trackwork

i. The curve may begin immediately beyond the last long tie.

ii. The minimum tangent length ahead of the point of switch to a curve in the same direction as the turnout for LRV storage, ROW equipment and Maintenance tracks may be 3.0 m.

c. Vertical Alignment

i. The maximum grade for Llew Lawrence OMF south Lead Track's approach to the Mainline Track may be 1.5%.

J. Stage 1 Considerations

1. Provide Shop Tracks R1, R2 and R3 as temporary light Maintenance tracks in Stage 1. These tracks are to be converted to ROW equipment tracks at Ultimate Buildout.

2. Maintenance tracks M1 through M5 and LRV storage tracks S1 through S3 are excluded in Stage 1.

7-3.11 SIGNALS

A. The Llew Lawrence OMF yard and building will have no signalling system.

B. All switches must be operated manually.

C. The border between the Llew Lawrence OMF yard and the mainline will be located at the two LRT block signals protecting the two lead and emergency tracks. Everything before those signals, and so within the Llew Lawrence OMF will not be signalled and controlled.

7-3.12 OVERHEAD CONTACT SYSTEM (OCS)

A. The Overhead Contact System must comply with the requirements as set out in Section 6-2.3 [*Overhead Traction Power System*] of this Schedule and the HFDG Section 6.4 – "Overhead Traction Power System".

B. The OCS must be a simple contact wire system consisting of one 350 kcmil solid grooved hard drawn alloy 80 (ASTM B9) copper magnesium (CuMg0,2) contact wire with no auto-tensioning system.

C. The catenary tension must be calculated as described in Section 6.4.4.3 [*Wire Tension*] and the HFDG Section 6.4.5.1 – "Tension Length and Tension Section".

D. Unless otherwise stated in this document the contact wire height must be as described in the HFDG Section 6.4.3.9 – "Contact Wire Height".

E. Placement of the OCS poles and supporting structures must be clear of the DVDE for all on-track vehicles. These clearance considerations must include all relevant loading conditions that influence the position of the OCS poles and wires. The clearances are defined in the HFDG Section 6.4.3.11 – "Clearances".

F. Upside down threaded screw clamps for OCS support from ceiling/door frames are not permitted.

G. The contact wire (except for inside the maintenance and storage building) must be staggered (stitched) +/- 200 mm from either side of center of track to maintain good current collection and uniform wear of the pantograph carbons. The stagger for curved alignments may be up to +/- 250 mm.

H. This stagger takes into consideration conductor blow off, contact wire height, span lengths, pole deflection, vehicle dynamics, width and sway of pantograph, along track conductor movement, track tolerances, and installation tolerances. For stagger specifications, refer to the HFDG Section 6.4.5.4 – "Contact Wire Stagger" and 6.4.5.5 – "Pantograph Security Analysis".

I. Throughout the Llew Lawrence OMF, the OCS must be sectionalized to separate the facility into distinct zones. Sectionalizing must be achieved through a series of break-before-make section isolators in combination with a series feeder and tie switches in the yard and DC contactors in the buildings. At the entrance to the buildings, back-to-back section isolators must be placed on the inside and outside of the doors with a separately powered catenary section between the isolators. This arrangement allows a deenergized but ungrounded section of catenary to exist between the energized yard and the grounded maintenance building.

J. Positive and Negative Traction Power Feeders and Returns

    1. Based on the sectionalizing of the building and yard, the positive feeder connections to the OCS must be strategically placed to allow maximum functionality of the facility while maintaining adequate voltage support to the trains.

K. The ballast loading track does not require OCS.

L. Stage 1 Considerations

    1. The Design-Builder must Design and Construct the yard OCS system following the track Design from the Stage 1 Option without precluding the Llew Lawrence OMF Ultimate Buildout.

    2. Storage lanes 4 and 5 are outside the building making them part of the yard OCS system.

7-3.13 SHOP AND STORAGE OCS

A. The OCS for the storage, maintenance, and wash tracks must:

1. Be a fixed tension design supported from insulated brackets, cross-spans and standoffs attached to the underside of the ceiling trusses and columns within the building using a built-for-purpose dropper assembly design.

    a. The dropper assembly design load capacity must be rated to handle at a minimum the required load of the OCS in the building plus an excess safety margin in accordance with Provincial building codes and standards.

2. Be terminated at each end of the building via a fork termination design that is fixed tension.

3. Be at a fixed height of 6.0 m from TOR.

4. Not be staggered.

5. OCS suspension must be coordinated with the building structure.

B. The OCS for the storage maintenance, and wash tracks must be configured as follows:

1. The OCS for all tracks must be capable of being energized or isolated independently of other tracks.

2. The OCS for the storage and wash tracks must be sectionalized at the mid-point allowing for a north/south partitioning of each storage track.

3. The north and south partitions of each storage and wash tracks must be capable of being energized and isolated independent of each other.

4. Due to the crossover in tracks W1 and W2 in the Wash Bay, the south partition of tracks W1 and W2 must be electrically connected as one section, they are either both energized or isolated.

5. To accommodate the use of storage lane 6 (S6) for storing ROW equipment, S6 must have OCS installed and be de-energized with only the maintenance supervisor being able to re-energize OCS. This dual use approach provides operational flexibility to the City.

6. The OCS for the maintenance tracks must have capacity to support two decoupled LRVs each.

7. The DC contactors and ground switches providing control of the OCS sections within the buildings must be placed adjacent to the OCS track sections which they control.

8. A minimum of one visual safety indicator at each side of each section isolator must be provided, the visual indicators must be appropriately configured to the operational environment such that they are clearly visible at all times, this includes the section isolator inside and outside of the south and north door of the storage and shop buildings and at either side of the midspan isolators.

    a. Visual and audio indicators for shop and storage OCS controls must be identical to what is currently implemented at the existing DL MacDonald OMF (red = energized; green = de-energized; yellow flash and audible tune = switching from de-energized to energized)

C. An OCS HMI display must be provided at the maintenance supervisors work/office area within the Llew Lawrence OMF which must:

1. Provide real time status of all DC traction power circuits at the Llew Lawrence OMF (yard and building) shown on an OCS single line layout.

2. Be capable of being displayed on a desktop computer as well as setup on a dedicated HMI display near the maintenance supervisors work area.

3. Ensure that the HMI display system has capacity to display real time status of all DC traction power circuits as part of this phase and future expansions of the Llew Lawrence OMF.

D. Stage 1 Considerations

1. LRV light maintenance is located within the ROW Equipment Storage footprint of the building.

2. The OCS must interface with the bridge crane and gantry in the ROW Building as follows:

a. The location of the OCS dropper assembly points within the ROW Building supporting R1 and R2 must be adjusted as follows to accommodate unimpeded movement of the bridge crane:

i. The OCS dropper assembly points for R1 must be offset 370 mm from centre of track towards track W2.

ii. The OCS dropper assembly points for R2 must be offset 370 mm from centre of track towards R3.

b. An integrated lockout scheme for the OCS must be implemented to ensure safe operation of the bridge crane and gantry, this lockout scheme must be based on the OCS control logic of the DC contactors and have the following conditions:

i. when DC contactors for R1 and R2 are not engaged and OCS is deenergized, movement of the bridge crane and access to gantry including the area near OCS is permitted;

ii. when DC contactors for R1 and R2 are engaged and OCS is energized, movement of the bridge crane and access to gantry is permitted, however the areas in proximity to energized OCS is restricted and blocked off via interlocked barriers and gates running parallel to the tracks;

iii. the interlocked barriers controlling movement between different section of the gantry must ensure safety using DC contactor control logic prior to granting access to different parts of the gantry;

iv. this lockout scheme must include a procedural step including lockout tagout, and a best common practice for added safety.

7-3.14 TPSS

A. The Llew Lawrence OMF TPSS must comply with the requirements as set out in Section 6-2.2 [*TPSS*] of this Schedule.

B. The Design-Builder must provide a dedicated TPSS at Llew Lawrence OMF. The supply from this TPSS must be segregated into a Yard Track TPSS and a maintenance building TPSS. Parallel redundancy must be provided between the Traction Power supply for Yard Track for Llew Lawrence OMF, and the maintenance building as described in the HFDG Appendix 6A – Figure 6.2B.

1. The Design-Builder must ensure that the DC switchgear assemblies at Llew Lawrence OMF TPSS consist of two groups of three track feeder breakers and one rectifier breaker.

C. The Design-Builder must provide Traction Power ducts to distribute positive and negative circuits from the TPSS to the OCS and rails as defined in the HFDG Section 11.11.3 – “Traction Power”.

D. The positive circuits and negative rail return for the Yard Track Traction Power System (TPS) must be electrically isolated from the positive circuits and negative rail returns of the maintenance building TPS.

1. The negative rail returns for the Yard Track TPS must be a floating system, electrically continuous throughout, and must be directly connected to the negative return of the Yard TPSS.

E. The running rails within the yard must be floating while the running rails within the maintenance buildings must be permanently grounded in accordance with IEEE 142.

1. The Design-Builder must provide control to mitigate stray current via use of sacrificial anodes.

F. The Design-Builder must ensure that the DC circuits within the maintenance building have adequate fault clearing protection.

G. All disconnect switches, DC contactor cabinets and ground switches must be clearly labeled. Appropriate visual signage describing the operation must be placed on the disconnect switch face. Wherever required, safety and hazard labels must be provided on the equipment.

H. Disconnect Switches

1. Design guidance for Infrastructure described in this section is provided in HFDG Section 6.2.14 – “Electrical Switches”.

2. The Design-Builder must provide disconnect switches mounted in a separate cubicle in the Llew Lawrence OMF:

a. ensure that each disconnect switch has a solid copper blade with silver plated contacts that is manually operated, single-pole and jaw-pressure-type, and an insulated operating handle;

b. the disconnect switches must be non-load break switches; and

c. design each positive disconnect switch with electrical interlocking feature to prevent operation under load.

3. The disconnect switches must provide a green and red indicating light on the front panel of cubicle where:

a. green indicates switch open; and

b. red indicates switch closed.

4. The disconnect switches must provide a simple operation instruction nameplate on the cubicle door.

5. The Design-Builder must prepare and submit the disconnect switches As-Built drawings.

6. The Design-Builder must provide layout, mechanical, control schematic and wiring drawings.

7. All inter-panel cables to include 10% spare wires.

8. The Design-Builder must provide logic drawings for all close, trip, lockouts, interlock schemes, transfer trips, etc.

I. DC Contactors and Ground Switches

1. Design guidance for Infrastructure described in this section is provided in HFDG Section 6.2.15 – “DC Contactors and Ground Switches”.

2. The Design-Builder must provide DC contactors and ground switches into the Llew Lawrence OMF. Each contactor and ground switches must be located in an enclosure and mounted in the proximity to the area they are controlling. The typical single-line diagram is defined in the HFDG Appendix 6A – Figure 6.2B.

    a. Provide control for shop personnel to safely energize and de-energize the maintenance tracks within the buildings via an automated DC contactor system and ground switch.

    b. The system must include PLC remote I/O modules, control switches and cabinets.

3. Ensure that the rating of the DC contactors, ground switches and fuses are appropriate for the TPSS ratings and the environment in which they are installed.

4. The DC contactor system must incorporate at minimum the following safety features:

    a. A means of manually locking out the controller when the ground switch is closed must be provided.

    b. The ground switch must be visible in both the open and closed position.

    c. The contactor must only close when all the following conditions are met:

        i. a manual close has been activated;

        ii. the ground switch is fully open;

        iii. line voltage is available;

        iv. no emergency buttons have been operated (PLC operated interlock); and

        v. no pre-existing faults are active on the contactor.

    d. Blown fuse indication is to be provided for all fuses in the fused splitter cabinet and wired to the PLC I/O module.

    e. Opened door contacts for the contactor cabinets and the fuse splitter cabinets are to be wired to the PLC I/O module.

    f. When 125 VDC control voltage is lost, the contactors will trip open.

    g. A warning horn with an adjustable timer must be provided. The contactor will close after the warning horn has sounded for a few seconds and the grounding switch has opened.

    h. The ground switch must be connected to the ground grid.

5. The DC contactor control module cabinet must provide LED indication lights for the overhead catenary system “Energized”, “De-energized and not Grounded”, and “De-energized and Grounded”, “Overload Trip”, “Short Circuit Blocking”. The module enclosure must have a three-position spring return selector switch to ungrounded and energize or to de-energize and ground a section. A kirk key must be released from the enclosure or selector switch only when the ground switch is confirmed closed.

6. The DC contactor and ground switches must be supplied with control voltage from the Llew Lawrence OMF substation 125 VDC Auxiliary Power System (DC Panel) to ensure that the system has full battery back-up.

7. Overhead status indicator lights must be provided for status indication of individual DC track circuits. Green indicates that the overhead line is de-energized and red indicates that the overheard line is energized.

8. The DC contactor control cabinets must be labeled according to the track ID number.

9. Interlocking requirements:

    a. Some tracks within the maintenance building must be equipped with gantry platforms. Access to the gantries should not be allowed while the overhead DC circuit is energized. Additional gates may be required on gantries that are spanning over two tracks such that access to either track is controlled.

    b. The Design-Builder must Design and provide an interlock scheme between the gantry gates and the respective DC circuit above its track. Each gantry gate must be interlocked. At a minimum, the following interlocking must be applied to allow the opening of the gantry gates:

        i. When the DC contactor is open and the respective ground switch is closed, a solenoid will be energized to allow the operation of a trapped key.

        ii. Once the trapped key is turned and removed, the DC contactor control power will be isolated.

        iii. This signal must be linked to a safety circuit to refrain the DC contactor to be closed.

        iv. With the DC contactor control power is isolated and the ground switch closed, another solenoid will be energized and allow the gantry gate opening. The solenoid energized and gate open status must also be linked to the safety circuit to refrain the DC contactor to be closed.

    c. The crane should not be able to operate if the overhead line is energized. Provide electrical interlock between the crane and the DC contactor system.

    d. The PLC interlocking and logic scheme must be programmed to accommodate the Llew Lawrence OMF Ultimate Buildout.

J. Load Flow Requirements

1. A load flow study for the Llew Lawrence OMF must be prepared and submitted by the Design-Builder to assess the capacity rating of the TPSS, the capacity for the different OCS zones and circuits within the maintenance shop and yard, highlighting any limitation that may be imposed on the operation.

    a. The load flow must be based on worst case scenarios and must consider:

        i. The maximum number of LRVs that could physically fit individual tracks and zones within the building and in the yard;

        ii. LRV auxiliary power duty cycle;

        iii. Combination of maximum number of LRVs that could be parked and powered-on (auxiliary power) when a maximum number of LRVs that could be moving (tractive effort) around the Llew Lawrence OMF;

iv. Combination of maximum number of LRVs that could be parked in the yard tracks and powered on during very low temperatures with maximum number of LRVs that could be parked and powered on within the buildings; and

v. Combination of a maximum of LRVs parked on yard tracks and powered on during very high temperatures with maximum number of LRVs that could be parked and powered on within the buildings.

K. Stage 1 Considerations

1. The Design-Builder must Design and Construct the TPSS including adequate capacity for the Llew Lawrence OMF Ultimate Buildout. The Llew Lawrence OMF Utility Complex TPSS room and duct banks must be sized accordingly.

7-3.15 SUSTAINABLE URBAN INTEGRATION

A. Llew Lawrence OMF Context and SUI Project Requirements

1. Part 2 [*Sustainable Urban Integration and Landscape Architecture*] provides the overarching requirements for SUI and the specifications for landscape architecture. SUI goals and objectives outlined in Section 2-1.3 [*SUI Goals and Objectives*] must be met. Additional SUI requirements that are specific to the Llew Lawrence OMF have been incorporated into this Section.

B. Landscape Architecture

1. In addition to the SUI requirements noted above, the planting requirements for the Llew Lawrence OMF in Part 2, Section 2-9.6.7.1.E [*Llew Lawrence OMF Specific Planting Requirements*] and the specifications for landscape architecture in Section 2-9 [*Landscape Architecture*] in this Schedule, the Design-Builder must meet the following objectives criteria for the landscape architectural Design:

a. use planting, in coordination with berming and building massing.

b. planting must encompass the entire Site with planting beds distributed throughout, locating planting where it will not conflict with Llew Lawrence OMF operations, and to achieve a visual connection to the surrounding landscape. Planting must not be concentrated in one area.

c. use durable and sustainable materials wherever practicable.

d. Design the edges that front onto 127th Street such that the perimeter physical barriers, fences and building massing integrate with the MacEwan Neighbourhood.

e. Design a staff patio area on northwest side of building with access from offices that must provide the following:

i. hard surfaced area to accommodate Site furniture and anticipated staff activities;

ii. hard and soft (landscape) screening from operations and track areas;

iii. Site furniture, such as, but not limited to: picnic tables, benches, waste receptacles, gas barbeque (including hookup), lighting, and enclosed/covered bike storage facilities to accommodate one full shift of staff.

2. The SWMF will act as a pedestrian hub and the following elements must be incorporated:

a. an asphalt SUP connection from the Llew Lawrence OMF to the SUP in the SWMF;

b. year-round landscape screening with views to the building.

3. The Design-Builder must include designated smoking areas within the yards of the Llew Lawrence OMF.

   a. Designated smoking area(s) must be located adjacent to personnel support areas and a minimum of 10 m from all windows and doors.

4. The administration building and associated parking on the north side of the administration building are not in contract. The Design-Builder must grade this area to achieve positive drainage and install topsoil and sod. No trees and/or shrubs will be planted in this area.

APPENDIX 5-7A: LLEW LAWRENCE OMF FUNCTIONAL PROGRAM

APPENDIX 5-7B: LLEW LAWRENCE OMF EQUIPMENT REQUIREMENTS

APPENDIX 5-7C: LLEW LAWERENCE OMF GENERAL TRACK LAYOUT

APPENDIX 5-7D: SHADOW DEVELOPMENT PERMIT

APPENDIX 5-7E: INTERIM MAINTENANCE SHOP LAYOUT

APPENDIX 5-7F: PERSONNEL COUNT