

APPENDIX 4L

**DETAILED VENUE
ANALYSIS: NEW EVENT
CENTRE**

CALGARY BID EXPLORATION COMMITTEE

VENUE BRIEF:

POTENTIAL NEW EVENT CENTRE:

PROPOSED Hockey Venue

CALGARY, ALBERTA, CANADA

PREPARED FOR

CALGARY BID EXPLORATION COMMITTEE, Master Facilities Plan

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DATE

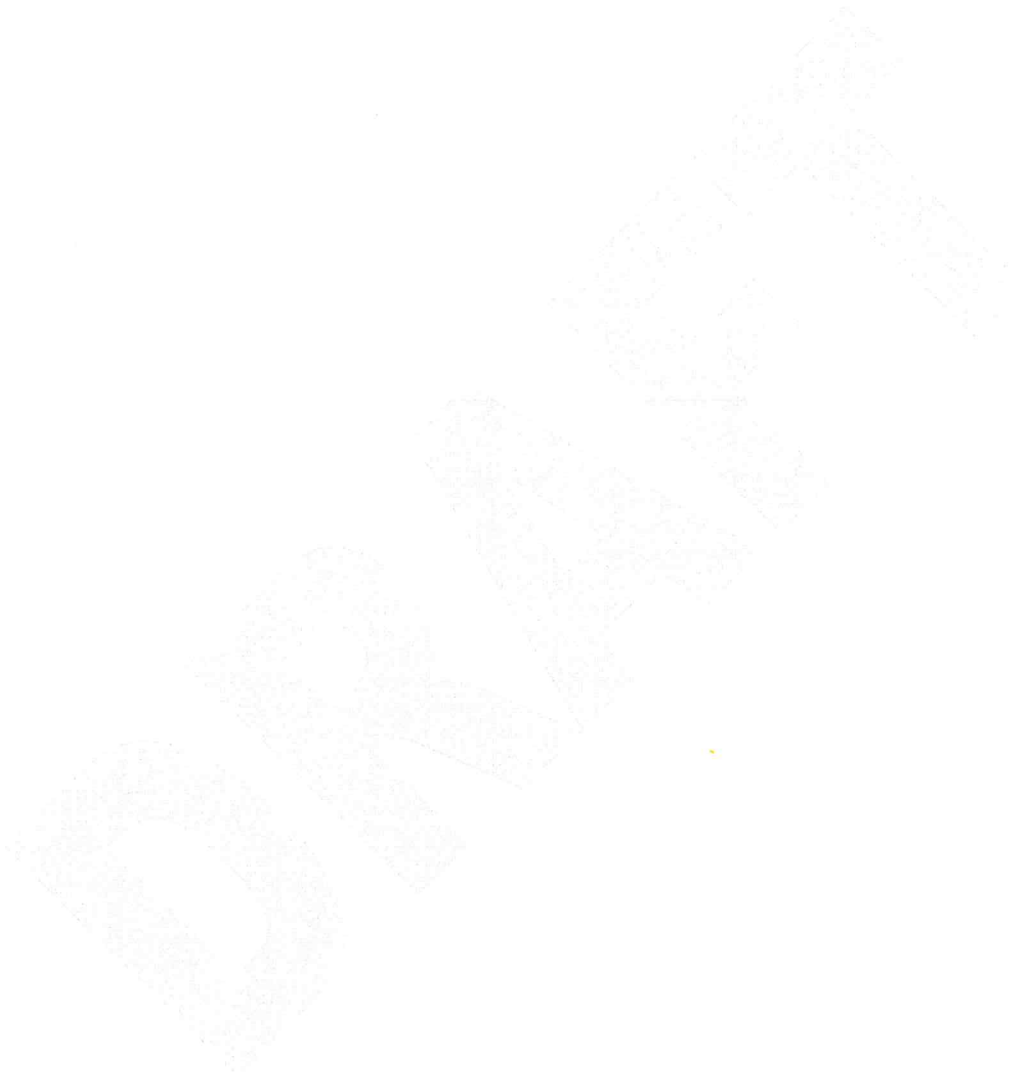
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INTRODUCTION

As part of an exploratory exercise to determine the feasibility of Calgary presenting a bid to host another Olympic and Paralympic Winter Games, a high level survey and study was conducted to review potential major competition and non-competition sites. One of the primary components of the exercise was to look at where there were synergies between venues and maximize existing infrastructure and transportation links/corridors.

The ability to cluster venues into precincts and parks provides substantial efficiencies in operational readiness, time, and costs. The Calgary Bid Exploration Committee (CBEC) focused their attention on Stampede Park and its venues for these existing efficiencies. The proposed new Flames Arena and ancillary arena would be potentially located within the Stampede Park and has been identified as the potential site for Ice Hockey 1 and 2, along with Para Ice Hockey competition.

The information contained in this document is to provide the Calgary Bid Exploration Committee (CBEC), Facility Owners, and Planning Teams further information on venue use, spatial requirements, and any challenges that need to be explored regarding this venue.

PROPOSED SCOPE & WORKING ASSUMPTIONS

The potential new Flames Arena has been proposed as a competition venue, hosting the following events:

Sport:	Ice Hockey
Discipline:	Ice Hockey (Olympic) Para Ice Hockey (Paralympic)
Events:	Men's Tournament Women's Tournament

Throughout the exploratory discussions the following working assumptions have been applied:

- NHL ice surface dimensions will be provided;
- Transition to Para Ice Hockey is considered and provided for in all athlete areas, surfaces, and FOP equipment;
- Ice plant is fully operational and sized for Olympic Games operations and use;
- HVAC is fully operational and able to meet games requirements for temperature and humidity levels;
- Hockey 1 Venue gross seating capacity minimum 18,000 seats, with Hockey 2 gross seating capacity minimum of 5,000 seats;
- Seating bowl is code compliant and meets best practice for accessible and amenity seating;
- Full venue is available for Olympic and Paralympic use including external compounds, parking, and all ancillary spaces. Shared or exclusive use periods to be determined during venue use agreement planning phase;
- Venue is located within Stampede Park, secure perimeters, vehicle and pedestrian screening, transport operations, and other amenities and services are provided for within the common domain or by the park;
- Lighting levels meet Olympic Games Broadcast requirements, see Appendix A;
- Roof structure has the capacity to hold additional loads for show lighting, cameras, flags, look banners and/or dimensional rings, audio, video boards, and score boards;
- Toilets are code compliant and meet accessible guidelines and best practice;

- Concessions are in good working condition with all services operational, code compliant, and accessible.

The material below is a non-exhaustive listing of the major areas and will act as a preliminary benchmarking tool when assessing the overall venues ability to operate as a Hockey 1 competition venue with Para Ice Hockey considerations. Hockey 2 venue operational space requirements are the same with smaller space allocation requirements, this document highlights some key Athlete and Media space allocation differences, but not all, as they will be addressed in the next phase of detail design. Using this material will provide the information needed to complete the next series of space studies to confirm flows, functional area space allocation, and develop further confirmation of required permanent works necessary.

As part of the Stampede Park, there needs to be further dialogue around the overall site access, egress, vehicular flows and Security Footprint, but as an initial phase of work the brief below will advise as to baseline requirements. There is minimal reference to the interior spatial requirements for the sport venues as most of the facilities have the primary requisites within their standard operating design, any gaps observed are noted at the end of the document for consideration. Further information on the Sport Federation and Media requirements will come later in the process.

HOCKEY BASELINE REQUIREMENTS

1 | General Venue Use

The Organizing Committee Olympic Games (OCOG) will need to take possession of the venue and its surrounding site areas to allow sufficient time for build out and overlay works. Build out requirements are based on the number of compounds, cabling requirements, and overall build scale and complexity.

A typical build out duration for a Hockey venue is approximately 6-12 weeks prior to athlete training start, this includes venue lock down, technical rehearsals, and hand over to the games time operations team.

Coordination between venue owner and the OCOG is required to confirm non-exclusive use and exclusive use periods to allow for games build out, games operations, and remediation of the venue and site post games. Hockey is an Olympic and Paralympic sport, which requires transition between Olympic Ice Hockey to Paralympic Ice Hockey. This transition includes works to the FOP and athlete areas, along with other minor venue elements. Remediation works to commence at the end of competition of the Paralympic Games, in coordination and alignment with park operations for coordinated park remediation operations.

Full use of the venue is required, including all exterior compounds, parking, ice maintenance areas, suites, food service areas, retail outlets, storage areas, home team locker rooms, offices, and facilities, and all operational spaces necessary to operate during the games.

2 | Front of House (FOH) Program Requirements

Front of House (FOH) areas are where spectator access, circulation, accommodations, and event viewing spaces are provided. FOH operations include spectator entry points, ticket scan, circulation concourses, concessions, ticket resolution, spectator services and information, retail outlets, toilets, water stations, spectator medical, and access to spectator seating and competition viewing areas.

As part of Stampede Park, the proposed new Flames Arena front of house operations are

modified as the secure perimeter of the venue is provided by the park, where security screening for both vehicles and pedestrians will occur. A venue perimeter fence line will still be required at the venue, where spectator entry and exits gates will be located with access to the venue through ticket scan portals. The entry and exit points will be determined through crowd modeling exercises with the park to established ticket scan through put rates to ensure optimal spectator flows in the park and load-in/out of spectators to the proposed New Flames Arena for competition.

General considerations for the front of house include providing spectator toilets and seating to meet best practices in accessibility, amenity seating, toilets, and concessions to ensure all spectators are able to enjoy the games without limitations. A thorough review of the venue's accommodations needs to be completed to determine where improvement works may be necessary to accommodate best practice and code compliance for an international sporting event. In addition to ensuring all seating is accessible and code compliant, all existing suites will need to be available for use in operations, sport production, international federation spaces, and additional spectator seating.

FOH areas optimally occur in existing spaces internally, however, there may be a requirement for additional spectator spaces to be provided to meet operations and games planning requirements. These spaces would be provided through temporary infrastructure in the spectator plaza's, entry spaces, and concourses. Internal space allocation and the requirements for external temporary spaces will be confirmed in the next phase of the venue confirmation and detailed planning.

a. FOH External Program Requirements

i. Venue Perimeter

A venue perimeter fence line is required for all venues within the park. This fence should be a minimum of 1.8m high, and ballasted to ensure stability in the event of heavy winds, creating a perimeter footprint of roughly 1-2m in depth. The fence will be covered in fence fabric with the look of the games applied, and entry and egress points. This enables the flexibility for Stampede Park to allow access to the park without tickets to a competition venue, and controls access to the proposed new Flames Arena to ticket holders and accredited pass holders only.

ii. Ticket Box Office (TBO)

A venue typically has a ticket box office located outside the venue perimeter, for ticket sales, will-call, or ticket related services. As part of Stampede Park, ticket box offices will be located centrally, no specific space is to be allocated for TBO at this venue.

iii. Ticket Scan

Ticket scan will occur in tent portals at the venue perimeter, the area and number of ticket scan portals will be determined based on the Stampede Park crowd modeling exercise, which will determine the spectator throughput rates into the venue, establishing the number of ticket scan portals required.

iv. Spectator Plaza

The spectator plaza occurs between the ticket scan and the venue, with direct access to the spectator concourses, where spectator amenities and services are provided, as well as access to seating and competition areas. The size of the spectator plaza will be determined through the crowd modeling exercise and spectator load-in/egress rates, based on venue spectator capacities and park crowd modeling. Also, due to multiple sessions, a venue spectator holding area is required with an area of approximately 3,500m².

v. Spectator Services – Plaza

Spectator services storage and staging areas are required for golf carts, wheel chairs, and stroller storage – this area should be no larger than 25m². In addition, an animal relief area, with direct access to potable water and drainage, is required. This area should be no larger than 10m².

vi. Exit or Blow Out Gates

Exit gates or blow out gates are located adjacent to the entry ticket scan portals. The number of gates is determined based on the venue capacity and park crowd modeling, to accept the exiting spectators from the potential new Flames Arena into the park general population and circulation.

b. FOH Internal Program Requirements

i. Spectator Services – Information and Storage

An area, existing or temporary, to be provided for spectator information, lost and found, and additional wheel chair and stroller storage. This space should be located centrally in the main spectator concourse area, and should be approximately 25m² in area with provisions for a counter to provide separation between event services staff and spectators. Use of the existing venues information office is preferred.

ii. Ticket Resolution

A ticket resolution office or area, existing or temporary, to be provided centrally in the main spectator concourse area. This area should be approximately 10m² in area, with provisions for a counter to provide separation between ticketing staff and spectators. Use of the existing venues TBO is preferred, if located within the venue perimeter.

iii. Concessions

Use of the existing concession areas to be provided, depending on the number of existing concession areas, additional temporary areas for concession sales may be required. Approximately 108 lm of concession counter space is required. A thorough review of the existing concessions conditions, operations, and services to be completed to determine if requirements for code compliance along with spectator accessibility best practice is provided.

iv. Retail Outlets

Use of the existing retail store outlet to be provided, depending on the size, additional temporary retail outlets may be required. Approximately 108 lm of retail outlet counter space is required.

v. Spectator Toilets

Use of all existing spectator toilets to be provided. A thorough review of the existing toilets to be completed to determine if upgrades are required to ensure all toilets provide the required accessibility provisions to meet best practice and code compliance per the venue capacity.

vi. Spectator Medical

Use of the existing spectator medical area to be provided. If the existing spectator medical does not exist, a space of approximately 50m² is required. The space needs to have water and drainage, along with direct access to an accessible toilet.

vii. Water Stations

Water areas to be provided in the venue through existing drinking fountains or water fill stations. Water to be tested for drinking water use. Number of stations to be compliant with venue capacity and located throughout the spectator concourse areas.

c. Other Major FOH Program Requirements**i. Seating**

The venues existing spectator seating gross capacity will net 15-20% less to accommodate for accredited seating and seat kills due to FOP build out, camera platforms, broadcast and press tribunes, and photo positions. Spectator services requirements and compliance to be aligned with this net capacity number.

3 | Back of House (BOH) Program Requirements

Back of House (BOH) areas are where sport, competition management and all venue operational spaces are located. Several spaces are required to be internal to the venue, with others in compounds outside the venue, with access to the venue for servicing and operations.

BOH operational areas include athlete areas, competition management, athlete medical, anti-doping, International Federation and Olympic Family areas, sport presentation, technology, food and beverage compound, cleaning and waste compound, workforce check-in and break areas, logistics compound, site compound, security, venue operations and management, broadcast compound, press operations (venue media center and press conference room), and venue accreditation. In addition, there are services compounds, parking, venue access points, and emergency services vehicle points required in the BOH.

General considerations for the external BOH compound spaces include paved surfaces for high traffic use – vehicle and pedestrian, along with structures – tents, cabins, containers, and equipment. Connections to water and waste, along with fibre is a plus to minimize additional works that would be required for necessary service connections. Overall drainage of the BOH compounds is critical for proper surface water drainage. Considerations for internal BOH spaces include direct connections to the external BOH spaces for cabling and venue servicing.

a. BOH Internal Program Requirements**i. Athlete Areas**

Space for all athlete areas should be provided inside the venue at the FOP level or with direct access to the FOP level.

The Hockey 1 venue requires twelve team locker rooms, with an additional two game day locker rooms, Hockey 2 venue requires 10 team locker room and no game day locker rooms. A typical hockey venue only has 2-4 existing locker rooms, this requires locker rooms to be provided through temporary infrastructure in cabin structures adjacent to the venue and integrated as a seamless connection to the BOH, FOP, and Athlete spaces. The space required for these additional locker rooms is roughly 3000m² in a compound space.

Additional athlete areas include twelve team storage areas, an apparel centre, athlete warm-up area and lounge, for an approximate area requirement of 900m².

Officials require a lounge, drying room, and locker room with an required area of approximately 150m².

All areas to be easily adapted to required IPC Para Ice Hockey accessible requirements in all athlete and officials areas, inclusive of toilets and shower facilities.

ii. Competition Management

The competition management space is where sport operations offices and work areas are located. The space should be located on the FOP level, or with direct access to the FOP level and athlete areas, with an area of approximately 300m².

iii. Athlete Medical

Athlete medical to be located on the FOP level with easy access to the ice and athlete areas, with a space allocation of approximately 150m², and connections to water and waste. In addition, all athlete medical areas are to be fully accessible, inclusive of toilet areas.

iv. Anti-Doping

If space is not available within the venue adjacent to the athlete locker and warm-up areas, anti-doping operations can be located outside the venue, with direct covered access to the athlete spaces within the venue. Anti-Doping space to be compliant with WADA space and processing guidelines, whether located within the venue or in a temporary cabin structure. The anti-doping space required is approximately 200m² and requires connections to water and waste. In addition, all anti-doping areas are to be fully accessible, inclusive of toilet areas.

v. International Federation

The International Federation (IF) for Ice Hockey is the International Ice Hockey Federation (IIHF) and the IF for Para Ice Hockey is the International Paralympic Committee (IPC), in coordination with the World Para Ice Hockey Technical Committee. There is a requirement for IF spaces within the venue for offices, meeting space, and an IIHF lounge. This space is approximately 500m² and should provide direct access to toilets.

vi. Olympic Family

The Olympic Family (OF)/Paralympic Family (PF) lounge and protocol offices to be located in existing lounge or club spaces or areas directly adjacent to the Olympic Family seating areas, with dedicated toilets. This space needs to be a minimum of 500m².

vii. Sport Presentation

Sport presentation includes spaces for medals ceremonies offices, presenter staging and dressing rooms, and mascot changing. These areas need to be located on the FOP level with easy access to the FOP, with an area of approximately 300m².

viii. Technology Operations

Dependent on readily available connections to fibre, there may be a requirement for compound spaces for technology and cellular structures, staging, along with containers for equipment and storage. This storage can be in the form of a tent or several containers. The compound space required is roughly 500m². Operational spaces for timing and scoring, work areas, and offices to be located on the production level with direct access to the FOP, this area is approximately 500m².

b. BOH External Program Requirements**i. Food and Beverage (FAB) Compound**

The food and beverage compound is the space for storage of both food and beverages, along with kitchen and food prep areas. Dependent on the venue, a temporary kitchen and additional storage is necessary to service all the additional lounges and food services outside concessions and standard venue operations. FAB sponsors, i.e. Coke, will also provide their own containers for storage on site and require a minimum of 1.5 days storage of products. This compound also requires offices, workforce areas, toilets, connections to water, waste, power, and easy truck access for daily off-hours food delivery. The compound space required is approximately 1000 – 1500m², depending on existing venue kitchen facilities.

ii. Cleaning and Waste (CNW) Compound

The cleaning and waste compound is an area for the staging of the large mobile collection bins, bin wash down area, compactors for the required waste streams, storage of CAW cleaning and paper products, along with offices. The compound space required is approximately 800m² with an additional area of 1000-2000m² for snow removal equipment and snow storage.

iii. Workforce (WKF) Check-In and Break

An area to be provided for workforce check-in and break areas adjacent to the venue and workforce accredited entry to the venue. These spaces can be in a tent structure, with workforce check-in space allocation at approximately 225m² and workforce break at approximately 1000m².

iv. Logistics (LOG) Compound

The logistics compound requires space for an office cabin, toilets, staging, and storage space. Additionally, this compound will provide containers for storage for other functional teams, dependent on in-venue storage, as well as parking for large equipment and vehicles. This compound is approximately 1000m², and must be secured due to the equipment and goods stored.

v. Site (VED) Management Compound

The site compound requires space for offices, toilets, staging, and storage areas for Site Management along with Energy, Look of the Games, and Signage and Wayfinding. Additionally, this compound requires parking for large equipment, vehicles, and spares with an overall compound space requirement of approximately 1000m², and must be secured due to the equipment and goods stored.

vi. Security (SEC) Operations

As a venue within the Stampede Park, a full PIDS system is not required, only a secure fence line and controlled entry points to separate and delineate the venue from other park venues and operations. These control points have accredited security check-points for operations and ticket scan entry areas and exits for spectators.

Accreditation access points are located BOH, with exception to one FOH accredited entry. Accredited entry points are provided for Staff, Olympic Family, Athletes, IF, and Media.

In addition, security operations require offices, control centre, briefing, and storage spaces – these can be in the venue or in an external compound tent or cabin structure, with a compound size of approximately 300m². Dedicated power and direct fibre connections are required to support their secure independent servers and operations.

vii. Venue Management Operations

If space is not available within the venue, a venue operations centre (VOC) is required. This space will house the offices for venue management and miscellaneous functional areas, event services offices and storage, venue briefing area, venue communications centre, and

storage as required. If located externally, these spaces can be in a tent or cabin structure, and is approximately 500m².

viii. Broadcast Compound

The Hockey 1 broadcast compound for the Olympic Broadcast Service (OBS) at the Winter Games, requires approximately 6000m² of clear open space immediately adjacent to the venue, Hockey 2 venue requires approximately 5000m². The compound provides Rights Holder Broadcast (RHB) spaces and OBS technical operations, offices, and connections to the International Broadcast Centre (IBC) and in venue operations.

The compound will also require its own dedicated generator compound, dedicated to OBS operations in the compound and at the venue. This space is roughly an additional 500m² of required space, directly adjacent to the BRD compound.

In venue operations include camera positions and platforms, commentator positions, mixed zone, broadcast studio, commentator control room (CCR), and Broadcast Information Office (BIO). The studio space is approximately 30m², the CCR space is approximately 50m², with the BIO approximately 25m².

ix. Press Operations

Dependent on space available in the venue, a Media Centre may need to be located externally to the venue, with direct access for the media to travel between the tribunes, photo positions, mixed zone, and the media centre. The media centre can be housed in a tent, with requirements for offices, lounge, lockers, and workroom. A media centre for Hockey 1 is approximately 1500m² and approximately 600m² for Hockey 2.

In addition, there is a requirement for a Press Conference Room – if space is not available in the venue with connections to the media center and the tribunes, it can be located next to an external media center, adjacent to the venue with direct access for the press and athletes to and from the tribunes and mixed zone, and is approximately 250m² for Hockey 1 and approximately 150m² for Hockey 2.

x. Venue Accreditation

A central park accreditation office is provided, no specific venue accreditation office is required for this venue.

c. Other Major BOH Program Requirements**i. Services and Access**

Access to water and waste, along with access to fibre connections is required for BOH compound spaces. In addition, there will be a Field of Play (FOP) and BOH energy requirement for prime generated power, along with redundancy generated power requirements. Energy compounds are broken into specific areas adjacent to the compounds and the venue with the most direct routes to reduce cable lengths. Roughly 4 compounds should be considered, outside the broadcast (BRD) compound, of approximately 500m² each.

ii. Parking and Vehicular Access

Each BOH compound will require parking within its compound for various operations. Additionally, Athlete's, officials, OBS and operational staff require parking – this can be as high as 150 parking stalls, with an area of approximately 4000m².

Further transportation planning with new and existing public and games transportation systems can reduce this number, along with park shuttle systems, but should not be less than 50 stalls for this venue.

BOH road access is dependent on available access routes in and out of the venue from the Park BOH transport and service roads within the park. A loop in and out of a venue is preferred, allowing for easy access of large trucks without backing up at any point of its entry into a venue. All security VSA's (Vehicle Screening Areas) will occur at park entries and not at this venue.

iii. Ambulance Staging

Emergency services vehicles will also require space within the venue BOH, dependent on the safety plans – fire trucks would be centrally located within the park, however, two ambulances

would be required for the venue – one dedicated to Athlete's and the other for Spectators. These ambulances are located adjacent to the building, with direct access to both the FOP and spectator areas, and require connections to power.

4 | Field of Play (FOP) Space Requirements

The field of play (FOP) is the area where Hockey competition takes place, on the ice surface. In addition, to the FOP area, there are several areas that are directly adjacent to the FOP which are also considered as part of the FOP. These areas include the player's bench, penalty boxes, scorekeeper's bench, athlete on and off ice areas, broadcast platforms, photo positions, medical positions, ice crew staging, mixed zone, and off ice operations.

General considerations for the FOP include agreed ice surface dimensions, humidification requirements for the ice, along with on ice temperature requirements for the athletes. HVAC systems need to be reviewed to confirm compliance for games, as modifications may be required.

Further, lighting levels are required to meet Broadcast lighting requirements, See Appendix A. Lighting may require modification to meet the lighting levels and to cover the ice surfaces.

a. FOP Ice Program Requirements

i. Ice Surface

NHL size ice surface has been agreed to meet competition requirements for all Hockey venues.

ii. On-Ice Areas

Standard IIHF and IPC Para Ice Hockey adapted boards, player's and penalty boxes are required.

b. FOP Off-Ice Program Requirements

i. Off-Ice Areas

Ice maintenance operations is located directly off ice and requires a space of approximately 150m² for staging of equipment. Use of existing venue pits, staging, plant and other ice maintenance operational spaces to use utilized.

ii. Mixed Zone (MZ)

The mixed zone (MZ) is the location where media interview the athletes immediately post competition, and is the pathway back to the athlete areas from the FOP. There are three areas required in a mixed zone, the athlete lane, broadcast and press corrals, and the circulation corridor to feed the broadcast and press areas. The athlete lane needs to be 2m deep minimum, the full length of the mixed zone. Broadcast requires roughly 21 (1.8m x 1.8m) positions with the circulation corridor behind, approximately 2m deep. Press requires roughly 35m length by 3m deep as a minimum, with the circulation corridor, 2m deep. Back drops are required on the Athlete side that may take an additional .5m space required the full length of the mixed zone. Access to the mixed zone is directly adjacent to the athlete off-ice area.

c. Other Major FOP Program Requirements

i. Training

Training and competition occurs at the venues along with additional training venues, creating long operational periods and requirements for services.

ii. Roof Loads

The FOP roof structure requires the capacity to hold additional loads for lighting, cameras, flags, look banners and/or dimensional rings, audio, internet and mobile antennas, video boards, and score boards. An estimated load requirement is 25 tons to meet games requirements. The structure should be surveyed to confirm load capacity.

iii. FOP Lighting

Requirements for broadcast level lighting must be provided at each venue to meet the OBS technical specifications for broadcast lighting. See Appendix A for the OBS Broadcast Lighting Technical Specifications.

VENUE TRANSPORT SUMMARY

Refer to Appendix 4AA

VENUE PROFILE SUMMARY

As the Hockey 1 venue is pending confirmation, a profile summary has not be developed.

VENUE GAPS, CHALLENGES, AND CAPITAL WORKS PROJECTS

With the assumption that Hockey 1 will be located in a new arena within Stampede Park, focus on working with the design development of this new arena is paramount to ensure games requirements are included into the venue design and program.

i. Venue Gaps

No gaps can be identified at this time, as the venue designs have not be confirmed for review and analysis.

ii. Venue Challenges

- Location identified in Stampede Park has challenges with BOH operational space and depending on the venues designs, may have impact to the overall shared operations within the Park;
- Flow of spectators to both the Hockey 1 and Hockey 2 venues around the Saddledome and IBC;
- Other challenges are unknown at this time, pending venue design.

iii. Capital Works Projects

Capital works projects are pending designs of the venues, the following listing is of areas that need special consideration during the design process to ensure games requirements are considered.

HVAC

Confirm humidification and temperature levels to meet IIHF requirements.

Roof Loads

Confirm roof loads of 25 tons.

Lighting

Confirm FOP lighting meets broadcast lighting requirements as noted in Appendix A.

Toilets

Confirm all toilets meet code for accessibility and best practice for family and amenity toilets.

Seating and Accessibility Compliance

Confirm seating meets code for accessibility and amenity seating, with locations at all levels of the seating bowl to ensure ability to provide accessible and amenity seating at all price points.

Exterior Services Connections

Confirm connections are readily available for fibre, water, and waste in exterior compounds, along with connections to power.

APPENDIX A: BROADCAST LIGHTING TECHNICAL SPECIFICATIONS



Esteem Projects & Consultancy

Date: 8th February 2017

Re: Olympic Broadcasting Service (OBS) summary of current Broadcast Lighting Technical Specifications.

Following is a summary of the OBS technical specification for broadcast lighting. The IOC and OBS would provide a comprehensive specification on confirmation of the Olympics Host City.

Below sets out the key areas for consideration when planning and design for games time lighting.

In addition to the completion area that require quality lighting are the non field of play areas such as

- Mix zones
- Press conference rooms
- Announcer positions
- Athlete holding areas
- Athlete pathways to FOP
- Spectator areas
- Warm up areas and Fields of play
- Medal and Flower Ceremony's
- Flags of Nations and Ceremony Flags

The technical specifications provide the detailed requirement for all venues. Sport specific requirements can vary between sports and venues. Consideration should be given to these specific requirements when formulating designs and equipment.

OBS Technical Specifications Summary Version February 2017

Light source (lamp)

The specified requirements apply to all light source (lamp) technologies e.g. HID (MHN, HQI, HSI, HIT, MSR, MSD etc.), LED, fluorescent etc.

Flicker

To support HFR production requirements and irrespective of the lamp technology e.g. HID, LED etc., the lighting shall be flicker free; the lamp driver/control gear shall be of the electronic type with an output frequency $\geq 1,000\text{Hz}$.

Low wattage lamps are preferred. The lamps shall be from the same manufacturer and from the same production batch.

Colour temperature:

The colour temperature, Tk, shall be 5600K (standard TV camera preset).

All lamps shall have the same colour temperature. That is, the colour temperature shall be nominally one value e.g. 5600K. Differences in colour temperature between different wattage lamps (at the FOP in question) are not acceptable.

It follows that if the competition of a sport is held at two (or more) venues, the FOP broadcast lighting of each shall have the same colour temperature.

Colour rendering¹⁰:

The CIE CRI Ra shall be ≥ 85 ;

and if no proven international standard installations of the lamp/luminaire system exist, a live field test with the intended light source/luminaire and a broadcast quality camera in cooperation with a national sports broadcaster shall be conducted and the results made available for review;

or

- Alternatively, TLCI11 Qa ≥ 85 ; or
- Alternatively, CRI Ra ≥ 85 and a R9 ≥ 45 ; or
- Alternatively, CRI Re(R1-R15) ≥ 85 .

If, for practical reasons (legacy, economics etc.), the lighting over the spectators has different lamp technology luminaires to the FOP, the colour temperature of these (spectators) luminaires shall not be higher than the FOP lamps.

Lighting equipment and operating conditions

The lighting equipment shall be suitable for the operating environmental conditions of the venue in question; and ensure that the lamps operate at the correct colour temperature and light output characteristics. The lighting equipment shall comply with the relevant host country's electrical safety standards. Luminaires shall comply with IEC 60598. The lamps shall comply with the relevant IEC lamp standards.

Winter Games outdoor venues, cold weather and lamp performance.

Extreme cold weather affects the proper functioning of all lamps (HID, HMI, fluorescent, LED). Apart from a lower light output, in particular the colour temperature may change significantly even between individual lamps and become unacceptable.

Lamps shall be operated on control equipment designed for very low temperatures so that the lamp operates to the stated nominal performance characteristics and meets the above requirements; and be utilised in luminaires designed for cold temperatures.

Anticipated light output losses due to low temperatures shall be factored into the lighting design.

The projected Games time temperatures shall be established well in advance.

Secondary warming (heating) the localised ambient temperature and air space control to ensure compliance should be considered. If necessary tests should be carried out to ensure the equipment would operate at the Games time predicted operating temperatures.

Calculation and measurement grids

Calculation grid intervals shall nominally be 2m (varies per sport – see specific sport requirements).

Illuminance towards a camera - known as camera illuminance, E_c , shall be on a plane nominally at 1.5m above the FOP surface.

Vertical illuminance, E_v , towards a nominated side of the FOP shall be on a plane nominally at 1.5m above the FOP surface.

Horizontal illuminance, E_h , shall be calculated/measured on the FOP surface.

Compliance illuminance measurement grid intervals shall nominally be 4m.

Note: the calculation plane shall match the gradient/slope of the FOP; e.g. cycling track, alpine skiing slalom; and/or the athlete's principal competition 'line' through the space above the FOP which may be a vertical plane e.g. skiing freestyle aerials, diving and ski jumping.

Camera locations

The camera positions modelled in a lighting design shall be as specified by OBS. Nominal camera plans are provided as production teams can survey the venues and formulate related plans.

HD, 4k and HDR

The on-going evolution from standard definition to high definition and beyond raises the question of

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illuminance levels. The reality is that with most professional broadcast camera system cameras, the sensitivity remains the same. In other words, the illuminance criteria herein remain the same for HD and 4K.

Similarly, high dynamic range (HDR) provides no additional restriction. At the time of publication 8K is in the early stages but it likely that the same requirement will prevail. The reader should check with OBS for currency.

Minimum illuminance

The minimum vertical illuminance at any point of the FOP shall be $E_c \geq 1,600$ lux towards the main cameras.

Note: the minimum average illuminance and the average horizontal illuminance are determined by the uniformity ratios. For HDTV/4K it is imperative the uniformities are met or exceeded.
The minimum vertical illuminance at any point of the FOP towards the orthogonal directions of the FOP, where camera #1 is central to a side, or 45° to the 4 sides of the FOP where camera #1 is not central to a side shall not be less than 70% of the minimum illuminance towards any main camera.

Uniformities for FOP

Vertical illuminance uniformity for each relevant main camera.

The minimum to maximum camera illuminance ratio, $E_{c \min}/E_{c \max}$, shall be ≥ 0.7 for the FOP; and ≥ 0.4 for the FOP-surround.

The minimum to average ratio, $E_{c \min}/E_{c \text{ ave}}$, shall be ≥ 0.8 for the FOP; and ≥ 0.6 for the FOP-surround.

Horizontal illuminance uniformity

The minimum to maximum ratio $E_{h \min}/E_{h \max}$, shall be ≥ 0.7 for the FOP; and ≥ 0.4 for the FOP-surround and/or run-off

The minimum to average ratio, $E_{h \min}/E_{h \text{ ave}}$, shall be ≥ 0.8 for the FOP; and ≥ 0.6 for the FOP-surround and/or run-off

The ratio of vertical illuminances at any point on the FOP between the orthogonal planes (at either 90° or 45° ; i.e. four calculation planes only) facing the four sides of the FOP shall be ≥ 0.75 and ≤ 0.9 .

The average vertical illuminance on the FOP towards camera #1, or the designated principal camera, shall be greater than the average vertical illuminance towards the other 3 orthogonal directions.

The uniformity gradient UG , for both horizontal (UG_h) and vertical illuminance to main cameras (UG_c) shall nominally be $\leq 10\%$ on a 2m calculation grid (varies per sport by interpolating the appropriate calculation grid).

The UG_v of the vertical illuminance towards the backlight side or sides where there are no fixed cameras shall nominally be $\leq 20\%$ at 4m grid intervals (varies per sport and interpolation).

The ratio of the average horizontal illuminance of the FOP surround to the average horizontal illuminance of the FOP shall be ≥ 0.6 and ≤ 0.8 , target 0.7.

Slow motion replay zone (SRZ): some sports will have a defined SRZ. In the absence of a specific SRZ requirement, the $E_{c \max}$ towards the main camera, shall be at the FOP centre.

Coefficient of variation (CV): the CV shall be ≤ 0.13 .

Maximum illuminance

Whilst firstly complying with the six basic specified uniformity criteria i.e. $E_{c \min}/E_{c \max}$, $E_{c \min}/E_{c \text{ ave}}$, $E_{h \min}/E_{h \max}$, $E_{h \min}/E_{h \text{ ave}}$, UG_c and UG_h , the maximum illuminance towards the main cameras, $E_{c \max}$, $\geq 2,000$ lux.

Luminaires and aiming logic

The luminaire-aiming angle shall be $\leq 65^\circ$. Light should reach any point within the total FOP from at least three directions where the third directional component should form a 'backlight' to one or both of the other two directions, with respect to the main cameras.

No luminaire shall be aimed directly at a camera, and not within a 50° cone centred on the camera lens. If the aiming point potentially coincides with a (hard/main) camera, the azimuth aiming angle shall be outside a cone of 50°.

A luminaire within the field-of-view (FOV) of the main cameras and aimed generally in a direction towards the cameras shall be constructed, or fitted with a glare-controlling device. The control shall be such that the light emitting area of the lamp is shielded from the camera's FOV or fitted with barn-doors, louvres or similarly acceptable devices.

Fit-for-purpose louvres, shields, hoods, barn-doors etc. may also be required to minimise the effects of glare, spill light and reflected (skip) light.

Equipment type and position shall be chosen to meet the specified glare limits.

Where the sport includes athlete action above the FOP surface (e.g. gymnastics, ski-jumping, diving etc.), there shall be light projected through the space above the FOP. The athlete's performance space in effect becomes the 'field of play' with respect to broadcast.

The total amount of light (luminous flux) projected from the camera #1 side shall not be less than the total luminous flux from the opposite side. Lighting equipment (luminaires, truss, cable looms, and chain motors etc.) located between the main cameras and the far side of the FOP shall be outside the cameras' field of view (FOV) when shooting the competition.

Noise – lamp control gear or drivers shall be silent (no ballast "hum"). Apart from aerial sports, in principle the luminaires should be designed, installed and aimed such that there is no light projected above the horizontal.

Multiple venues for one sport

Some sports take place at two or more venues accommodating preliminary rounds and the finals. The BRD LX quality of the two (or more) venues shall be the same, or as close as possible – a difference of not more than 5% of both the average horizontal and the average vertical illuminance (to camera 1). The colour temperature shall be the same or not more than a 5% differential.

The baseline lighting quality shall be set by the venue that stages the finals.

End of Technical Specifications

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End of Report

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