1. SCOPE

Free TV Australia Operational Practice 37 is a guideline for the minimum requirements for television coverage of swimming competition. It provides an indication of infrastructure for an outside broadcast production using contemporary production techniques which meet broadcast television presentation requirements.

This Operational Practice has been developed by the Free TV Australia Project Group - Outside Broadcasts in the interests of maximising TV and Radio production potential and productivity at sports venues and avoidance of costly omissions at planning and construction stages.

TVOB coverage of swimming has progressed with the general availability of "super slo-mo" cameras and digital cable-less (wireless) cameras and a range of special effects cameras and the progressing implementation of high definition television (HDTV) technology. These developments have increased the venue space requirements for TV OB operations and imposed more stringent requirements on lighting specifications for indoor events.

2. TYPICAL COVERAGE

2.1 CAMERAS

The configuration of a typical venue will be:

Cameras covering the pool	16
Network Host cameras	2

2.2 CAMERA POSITIONS

2.2.1 Camera 1 Start / Finish

Hard camera on scaffold, located in line with the start/finish line of the pool at the top of the grandstand, nominal height of 15 metres above the pool, and 15 metres back from the pool edge. Master shot 55x lens.

2.2.2 Camera 2 Start / Finish Slo-Mo

Super Slow Motion camera on scaffold located in line with the start/finish line of the pool at a lower level of the grandstand, at a nominal height of 3 metres above the pool and 4 metres back from the pool edge. Mid tight shots / iso record finish. Super Slo-Mo. 70x lens.

2.2.3 Camera 3 50 metre turn

Hard camera on scaffold located in line with the 50 metre turn at the top of the grandstand, nominal height of 15 metres above the pool, 15 metres back from the pool edge 55 x lens.

2.2.4 Camera 4 Tracking Dolly

Located on the edge of the pool deck, track is laid parallel for the entire length. Low tracking shot. 30x lens.

A "piggy back" camera mounting may be employed to provide simultaneous tight and wide camera angles across the pool.

2.2.5 Camera 5 Portable (RF) camera, Pool deck

Portable camera working the pool deck for close up coverage. Wide angle 4.5 x lens typical.

2.2.6 Camera 6 Portable (RF) camera, Pool deck

Portable camera working the pool deck for close up coverage. Wide angle 4.5 x lens typical.

2.2.7 Camera 7 "Mobycam" (proprietary system)

Waterproof remote controlled mini- cam submerged at start end of pool.

2.2.8 Camera 8 "Mobycam" (proprietary system)

Waterproof remote controlled mini-cam submerged at 50 metre turn.

2.2.9 Camera 9 "Mobycam" (proprietary system)

Waterproof remote controlled camera submerged below Lane 4, and tracking full length of the pool.

2.2.10 Camera 10 Overhead Tracking camera (proprietary system)

This is a proprietary camera system which provides a down looking remote controlled camera above the pool, tracking the full length of the pool. Such camera systems require pre installation of track supports and track and typically require free access to the pool area in the days leading up to the event. Installation and operation of overhead tracking camera systems will be a special requirement for major events and will be negotiated between TV broadcasters and venue managements in the lead up to the telecasts.

2.2.11 Camera 11 50 metre turn Slo- Mo

A super slow motion camera on scaffold or platform in line with Lane 4/5 located behind the 50 metre turn, typically at a height of 5 metres above the pool level and 10 metres back from the pool (subject to architectural aspects) The camera is used for close-up slow motion replays and a &ox lens is typical.

2.2.12 Camera 12 Crane camera, Pool deck

A cabled portable camera mounted on a "Jimmy-Jib" or similar lightweight camera crane with jib length in the order of 5 metres. The crane base is located on the pool deck (of the diving pool) behind the Start / Finish, and out of the competition traffic area. The jib length allows for camera angles above the warm up area, starting blocks and dais. A 5.2 x lens is typical.

2.2.13 Camera 13 Marshalling area

A cabled portable camera (with tripod option) located in the marshalling area for cover of pre-race activity.

2.2.14 Camera 14 Flash Interview

A cabled portable camera located at the competitors exit from the pool area for post race interviews of competitors and officials.

2.2.15 Camera 15 "Mobycam" (proprietary system)

Waterproof remote controlled mini cam at starting block 4.

2.2.16 Camera 16 "Mobycam" (proprietary system)

Waterproof remote controlled mini cam at starting block 5.

2.2.17 Camera 17 / 18 Host Cameras

Cabled portable cameras at the on-camera host position for program presentation.

OR

A style camera mounted in the commentary remote controlled mini-camera area positioned for cover of the commentary team. 5.5x lens.

2.2.19 Final Camera Placement

The above camera positions are typical of swim meet coverage, but final camera placement will always be at the prerogative of the programme producer and director. Camera numbering above is indicative, and individual directors will nominate camera numbers for compatibility with their individual camera switching technique.

2.2.20 Wireless Camera Microwave Platform

A platform for operation of wireless camera microwave receivers is required within the venue. Nominal dimensions are in the order of 2.4 metres wide x 1.5 metres depth. The actual location will require RF testing within the venue

prior to a final decision as RF propagation within the highly reflective confines of an aquatic centre can prove highly demanding.

2.3 COMMENTARY AREA

The commentary area should be positioned above the start/finish line of the pool, located in the grandstand at a height of 15 metres above the pool and 15 metres back from the pool. The commentary area may be accommodated in a formal commentary box or more commonly at aquatics venues on a purpose constructed scaffold platform.

The internal dimensions of the commentary area should be 4 metres wide by 4 metres deep by 3.6 metres high. The configuration should be such as to accommodate four commentators and statistician at a commentary desk along the frontage of the area. In the case of an enclosed commentary box the front wall should consist of sliding glass windows that allow the option of open access to the pool or acoustic isolation.

2.3.1 Host Position / Studio

A host presentation area is required to accommodate on-camera hostings and interviews. Area required is typically 4 metres x 4 metres and can be incorporated in the commentary area or a suitable area within the aquatic centre as negotiated between venue management and TV. (The diving tower has been assigned as the host position in some instances). Provision needs to be made for installation of lighting bars in the hosting area for support of TV lighting fixtures. Positioning of lighting bars is to be determined during consultation between venue management and TV technical staff.

Where commentary area and / or host area are enclosed spaces, the area needs to be air conditioned with capacity to cope with a nominal 12 person heat load plus studio lighting load. Evaporator fans need to be low noise units (Not to exceed NR 35) with local control for optional shut down during studio on air segments.

2.3.2 Mains Power

Power availability in the commentary box / host area should be able to support 30 amps per phase on multiple outlets. All power reticulation to the commentary box and pool deck area is to be RCD protected with a trip current of 30mA (maximum).

2.3.3 Poolside Commentary and interview position

Provision is to be made foe poolside interview and colour commentary operations.

Personnel additional to commentators are producer, floor manager, cameraman and assistant, and audio assistant.

Space provision also needs to be made for a half equipment rack to house wireless mic and associated equipment.

2.3.4 Wireless Microphones

Wireless microphones are extensively used for TV and radio interviews. Wireless mic frequency co-ordination is required on a venue by venue basis to avoid interference with TV operations, radio broadcasters, venue officials, public address announcers, entertainment, and other legitimate users of wireless microphone equipment.

2.3.5 Radio Frequency (RF) Spectrum Management

Extensive use of the RF spectrum is necessary for comprehensive TVOB cover of swimming competition.

Allocation of frequency bands is generally as follows:

- 2.5 GHz microwave band: Portable wireless cameras
  In-car camera uplinks
  Relay helicopter down links
  Camera helicopter down links
- 7 / 8 GHz microwave band Medium haul point to point back haul links
- 13 GHz microwave band Short haul point to point back haul and local interconnect links
- 470 – 520 MHz band Duplex Radio Telephone (RT) voice communications
  Telemetry and data communications
- 520 – 820 MHz band Wireless microphone operations
- Aggregate RF systems requirements can be in the order of 12 x 2.5 GHz channels, 4 to 6 x 7 / 8 GHz channels, 4 to 6 x 13 GHz channels
- 10 x UHF duplex RT frequencies and 4 to 6 x wireless microphone frequencies

RF spectrum usage is strictly controlled, and specific channel allocations are generally licensed to individual commercial entities. Temporary use of multiple frequencies as is required for operations on the major event scale require frequency co-ordination with established license holders and special licensing for the complete RF requirements for the period of the event.

It is essential that a rigid frequency management procedure be implemented on a venue by venue basis to ensure non interference between services within the precinct involved in TVOB origination, including authorised unilateral operators, and for other licensed users (ENG etc.) operating in near proximity to the OB precinct.

Wireless microphone frequency management is the prerogative of the event promoter and venue management, but TVOB operators need to be fully involved in channel allocations from the early planning stage of the project.

Microwave and UHF frequencies are licensed but may be subject to frequency sharing arrangements. Co-ordination between users, including news services not directly involved in the event telecast, but licensed to operate in proximity of the event precinct is an essential pre-requisite for event RF spectrum planning.

Major events involving multiple operators of RF services require overall coordination to be under statutory authority control of use / misuse of RF spectrum assets.

3. OUTSIDE BROADCAST COMPOUND

3.1 General

A level hardstand area for outside broadcast control units (OB Units) parking is required convenient to the camera platform/ TV commentary box area.

The OB van compound should be fenced off from public access for security of TV operations, and for public safety.

Major outside broadcast vehicles are semi trailer units built to Australian road transport regulations Venue vehicle access and load bearing capacity needs to comply with maximum vehicle dimension and weight specifications. Typical requirements are 17.5 metres combined trailer and prime mover length, maximum height of 4.3 metres, and 8.5 tonne per axle loading.

Typical hardstand area is in the order of 500 square metres either 25 metres x 20 metres or 50 metres x 10 metres, rectangular.

Access to and egress from the OB compound needs to cater for the turning circle and overhead clearance requirements of maximum dimension articulated vehicles.

Special attention to overhead obstructions is necessary where ramps or uneven road surfaces are involved.

Generator hardstand should be incorporated in the OB compound (see below).

Provision is to be made to site a satellite uplink vehicle within the compound, or adjacent to the compound with clear line of sight to the North-East sky.

An additional area of nominal 300 square metres should be available for international unilateral operators.

3.2 Personnel Amenities

Adequate personnel services need to be provided in the OB compound. These amenities should include:

- Toilet facilities, separate male and female facilities
- Sewer or self contained connection, town water connection

- Drainage contours such as to minimise "ponding" during heavy rainfalls
- Food preparation area and catering area
- First Aid facility
- Regular cleaning and rubbish removal services

4. POWER

4.1 Typical Requirements

Typical power requirement is for 150 Ampere per phase three phase supply adjacent to the outside broadcast vehicles hardstand area. Power should be available over 4x three phase outlets or via 'Power-lock' bulk connectors. Industry standard power connections are Cutler Hammer DS63 outlets, Wilco 5 pin 3 phase (40 amp/50 amp) connectors and outlets and / or "Power Lock" bulk supply connectors.

4.2 Heavy Neutral Currents

The high level of use of switch mode power supplies in TVOB technical equipment has resulted in high neutral current drain in three phase mains supplies. High current neutral connections should be specified for mains power installations planned for TVOB compounds.

4.3 Circuit Breakers and Safety

Where mains power supplies are protected by residual current devices (RCDs) trip current of the source RCD should be adjustable, to be set to a higher trip current level than the main OB van circuit breaker, such that the OB van main circuit breaker serves as the prime safety switch for the TVOB operation.

TVOB mains supplies are to be separately protected from other electrical supplies servicing the entertainment venue.

Power reticulation ex the OB van to operational areas is to be RCD protected in accordance with Work Safety requirements.

4.4 Local and Standby Emergency Generators

Generator hardstand should be incorporated in the OB compound and should be adjacent to the mains power connect point.

Sourcing of generators is a TVOB responsibility. Generators are to be silenced to EPA requirements and are to be sited to obviate exhaust fume exposure to TVOB staff and patrons.

Where generator hardstand cannot be within the OB van compound interconnect cabling specified to full electrical load (150 Amps / phase, three phase) is required to be installed between the generator site and the OB Compound.

Three phase 30 Ampere rated interconnect cables (Wilco 5 pin connectors) are to be installed between the OB Compound and Commentary box / Studio area, and between the OB Compound and sideline for extension of OB van power to main operational areas.

5. AUDIO / VIDEO (A/V) CONNECTIVITY

5.1 General

TV program material may be required to be fed to and occasionally returned from other locations. Full quality feeds from the OB unit to another location such as a broadcast station should be over a "Contribution" quality circuit.

Both Standard Definition (SD) and High Definition (HD) picture formats are now expected to be in 16x9 wide screen. For SD, the preferable video connection is component serial digital video (SDI) with at least stereo audio. The alternative for SD and necessary for HD are digital link connections that use MPEG compression systems. However, the degree and type of compression, and as a consequence, the quality loss on such "contribution" circuits, need to be pre-confirmed. In certain circumstances if no other connection is possible, if agreed, an analog video link may be used for SD program material.

Audio requirements may include enhancements such as "Pro-logic" surround stereo encoding or discrete multichannel surround (eg. 5.1 surround). Multichannel audio may be carried in digital AES/EBU circuits in "Dolby-E" format. Additional audio channels may be required if separate music and/or effects channels are required.

In all cases, care is required to ensure that picture-sound delay offsets (lip-sync) are within limits.

5.2 Venue Audio / Video (A/V) Connections

The connect panel for venue A/V services should be located in the OB compound, co sited with TVOB cable terminations and Telco services.

TV signals emanating from the OB unit will generally be 16x9 wide screen digital video, and at least stereo audio.

The venue A/V service provider would need to provide a format converter for reticulation to any 4x3 in house monitors.

Interface connectors for off-air TV distribution, venue A/V distribution, Foxtel cable and venue phone should be available at the connect panel.

(Refer to Addendum # 1, Cable Installations)

6. OFFICIAL TIMING

Provision needs to be made at the A/V panel for connection of video, data and communications services between the OB van and the official time-keeper.

7. CABLING

7.1 General

Simple access is required for cabling from the outside broadcast vehicle hardstand to the main camera platform, commentary area, host area, pool deck, and special camera operations areas.

TV cable installations are site specific and need to be planned on an individual basis, but provision needs to be made for cable routes which provide ease of access, do not compromise venue aesthetics and do not present risk to workers or public.

Cable routes within the venue should allow for obstacle free installation and removal of cables.

Wherever possible, ground level cable paths clear of public traffic areas are preferred.

As a general rule, provision for day cabling allows for full cable install within a 20 man hour rig time and de-rig within 12 man hours.

Cable conduits are not recommended for temporary cable installs, but where there is no other option conduits should be a minimum 150mm diameter with draw wire installed. A minimum of 3x conduits should be available in order to separate signal cables from power cables, and to allow for (inevitable) future expansion.

A special consideration for aquatics venues is for cable access to the pool deck via sub floor voids with cable hatch penetrations to allow cabling directly to the starting block area without crossing the pool deck.

7.2 Permanent Cable Install

Cable routes in major Aquatic complexes may be such as to preclude day cable installs.

In such cases permanent installations become the only option.

It should be recognised that TV production techniques change, particularly with equipment innovations, and that cable installations are subjected to continuing upgrades.

Implementation of HDTV equipment is impacting on cable installation with increased demand for Fibre optic camera cables, precision digital video coaxial cable, and (multi way) fibre optic cables for utility use.

Co-axial video cable is to be specified for end to end delivery of uncompressed digital video over the installed length of cable.

Cable types and cable technical specifications alter with advances in technology so cable schedules need to be updated prior to planning any permanent installation.

Permanent cable installations should be planned in consultation with venue management and TV Rights holders, with emphasis on specifications for cables, connectors and locations of outlets.

For multi-purpose venues, the total installation should encompass the highest common requirements of all possible event cabling.

Provision needs to be made for replacement and upgrade of such installations.

Preference is for cantilevered cable trays exclusive to TV cabling. Conduits – if provided – should be free of turns no less than 120 degrees from any change of direction. Where conduits are the only option, 150mm diameter is the minimum specification, and multiple conduits should be available to all operations areas with provision for upgrade and expansion.

(See addendum # 1 TVOB Cabling requirements for Aquatic competition venues)

8. BACKHAUL

8.1 General

TVOB transmission to studio base can be via Telco circuits, satellite uplink or local microwave radio transmission.

The Telco access point should be adjacent to the OB compound.

Space provision for a satellite uplink vehicle with clear view to North-East sky is required within or adjacent to the OB compound.

8.2 Microwave Link Platform

A 2.0 m x 2.0 m platform is typically required for TVOB backhaul microwave link installation.

The platform is to be sited to allow clear line of sight radio transmission to the TV studios or to a suitable intermediate relay site.

A microwave platform may also be required within the stadium for mounting of (manned or unmanned) wireless camera microwave receivers.

The provision of microwave link platforms at the stadium will depend on the surrounding topography and available link paths in and out of the stadium.

Any structures need to comply with relevant Occupational Health & Safety Regulations.

9. LIGHTING

(Reference should be made to FREE TV AUSTRALIA OP 31: *Lighting Requirements for Colour Television.*)

9.1 International Standard for Colour TV Lighting at Venues

Design criteria for development projects should meet an international standard with mechanical and electrical specifications to provide for upgrade to (future) HDTV standards.

Lighting level (EV) toward main cameras	1400 lux
Colour temperature (TK)	4000 Kelvin to 5600 Kelvin within 500 Kelvin at individual venues
Colour rendering index (Ra)	90

9.2 National and Local Standards

Existing stadiums that do not meet international standards are classified as follows:

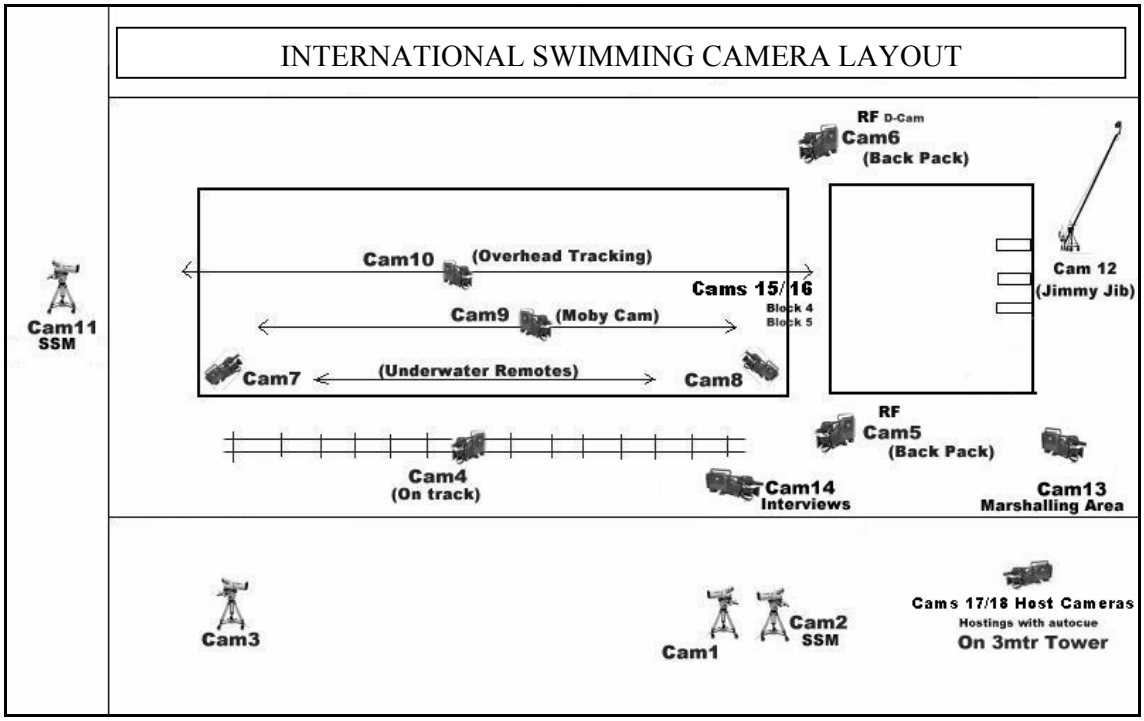
9.2.1 Professional Standard
(Minimum standard for TV cover)

EV toward main cameras	1000 lux
Colour temperature	As above
Colour rendering index (Ra)	> 65, > 90 preferred

Whilst satisfactory picture quality can be achieved at the minimum lighting levels stated (1000 lux), restrictions are placed on full usage of telezoom lenses and focusing becomes quite difficult for camera operators on BCU (big close up) camera angles. Super Slo Mo cameras cannot perform satisfactorily below PROFESSIONAL standard lighting.

Figure 1. Nominal Camera Positions

INTERNATIONAL COVERAGE



10. SAFETY

All personnel working on TVOBs are to be familiar with and to comply with relevant OH&S regulations.

A site specific risk assessment is to be undertaken by venue management and TVOB operations management during planning stages of the event.

TVOB personnel are to be inducted as to venue and TVOB safety requirements prior to commencement of duties.

Scaffolding, camera tracks, aerial cabling and other constructions are to be installed by suitably licensed persons.

Camera cranes, scissor lifts, fork lifts and other mobile work platforms are to be operated by licensed persons.

Electrical installations are to be undertaken by licensed persons, and tested and tagged in compliance with statutory regulations.

Temporary TV cable installations are to comply with site hazard reduction policies.

As safety regulations can vary subject to individual state government regulations, applicable requirements need to be determined on a site by site basis.

Special precautions are essential to ensure electrical safety and trip hazard safety in the pool deck and other wet areas. Power reticulation from the OB van to operational areas and to the pool deck to pool deck area (Mobycam, tracking dolly etc) is to be RCD protected. Single phase distribution circuits are to be individually RCD protected. TV cables are to be run out of traffic areas, flown above floor level where appropriate and "Gaffer" taped in situ. Mini cameras are to be low voltage operated. Wireless cameras are to be used where appropriate on the pool deck proper.

During planning stages of new aquatic centre developments, voids below pool deck level with cable ways to the dais / starting block area and cable entry via purpose built cable hatches can be planned to minimize cable trip hazards in the pool deck area.

ADDENDUM # 1

CABLE INSTALLATIONS AT SWIMMING COMPETITION VENUES

NOTE:

- Implementation of HDTV equipment is impacting on cable installation with increased demand for Fibre optic camera cables, precision digital video coaxial cable, and (multi way) fibre optic cables for utility use.
- Co-axial video cable is to be specified for end to end delivery of uncompressed digital video over the installed length of cable.

The following cable listings are typical of requirements for swimming competition telecasts but intended only for guideline reference. Cable types and cable technical specifications alter with advances in technology so cable schedules need to be updated prior to planning any permanent installation.

Permanent cable installations should be planned in consultation with venue management and TV Rights holders, with emphasis on specifications for cables, connectors and locations of outlets.

Outside Broadcast Compound to Main Camera Platform

3x Fibre optic camera cables
3 x triaxial[1] camera cables
2 x digital coaxial video
1x single phase power

Outside Broadcast Compound to Overhead Tracking camera control area

4 x digital coaxial video
1 x triax camera cable
1 x single phase power interconnect cable
1 x 20 pair Telco (Audio)
1 x 20 pair Telco (data)
2 x Cat 6 computer cable

Outside Broadcast Compound to Pool deck (start area)

8 x digital coaxial video
1 x 8 way multi fibre optic cable
1x 12 way audio multi-mic cables
1 x 20 pair Telco (Audio)
1 x 20 pair Telco (Data)
1 x single phase power interconnect cable
2 x Cat 6 computer cable

[1] Installed Triax cables are to be 11mm or 14mm diameter as required to meet HDTV performance requirements over the installed length of the cable (including any "day cable" extensions to the installed cable. Maximum working lengths are 1000 metres for 14mm cable and 500 metres for 11mm cable

Outside Broadcast compound to behind start

1 x Triax camera cable
1 x Fibre optic camera cable

Outside Broadcast Compound to behind 50 metres

1 x Triax camera cable
1 x Fibre optic camera cable

Outside Broadcast Compound to pool deck tracking camera operations

(Mobycam)
8 x digital coaxial video
1 x 8 way multi fibre optic cable
1x 12 way audio multi-mic cables
1 x 20 pair Telco (Audio)
1 x 20 pair Telco (Data)
1 x single phase power interconnect cable
2 x CAT 6 computer cable

Outside Broadcast Compound to wireless camera Microwave Platform

4 x Microwave Triax
1x Single phase power interconnect cable
1x RF coax
4 x digital coax video
4 x audio
2 x Cat 6 computer cable

Outside Broadcast Compound to TV Commentary / Host area

2 x Fibre optic camera cables
2 x triaxial[2] camera
6 x digital coaxial video
2x 12 way audio multi-mic cable
1 x 20 pair Telco (Audio)
1 x 20 pair Telco (Data)
1 x 30 Amp per phase three phase Wilco 5 pin power interconnect cable
1x CAT 6 computer cable
1x 8 way multi Fibre optic cable.

Outside Broadcast Compound to A/V

Off Air TV reticulation
Venue A/V reticulation
Venue comms

[2] Installed Triax cables are to be 11mm or 14mm diameter as required to meet HDTV performance requirements over the installed length of the cable (including any "day cable" extensions to the installed cable. Maximum working lengths are 1000 metres for 14mm cable and 500 metres for 11mm cable

2 x Cat 6 computer cable for possible interface to venue IT services
Other services to be specified by venue A/V service provider

Outside Broadcast Compound to Time Keepers facility

4 x Cat 6 data cable
5 x coaxial video
5 x Audio
2 x 20 pair Telco
1 x single phase power

Outside Broadcast Compound to Backhaul microwave platform

2 x Microwave Triax
1x Single phase power (to connect to OB Van)
2x RF coax
2x (digital spec) coax video
4x audio
2 x Cat 6 computer cable