



Infrastructure Corporation of Andhra Pradesh Limited (INCAP)

REQUEST FOR PROPOSAL (RFP) (International Competitive Bidding)

Corrigendum – Annexure II: Design Guidelines

SELECTION OF THE DEVELOPER FOR A CONVENTION CENTRE AT VISAKHAPATNAM IN ANDHRA PRADESH ON PPP BASIS

(September 2015)

(BID DUE DATE: 16-10-2015)

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Disclaimer

1. Information contained in this Design Guideline is for the sole purpose of creating an efficient, attractive and successful Convention Centre facility and its associated facilities. If any contradiction or discrepancy is found in the information contained here with the Request for Proposal Document issued by the Infrastructure Corporation of Andhra Pradesh Limited (INCAP) then the latter will be the criteria for all purposes and intents.
2. All Designs and Drawings must adhere to Building Construction and Safety Guidelines applicable to the site and must be approved by INCAP along with the relevant Municipal Government authorities prior to construction.
3. The plans have been prepared on the following project sizing assumptions:

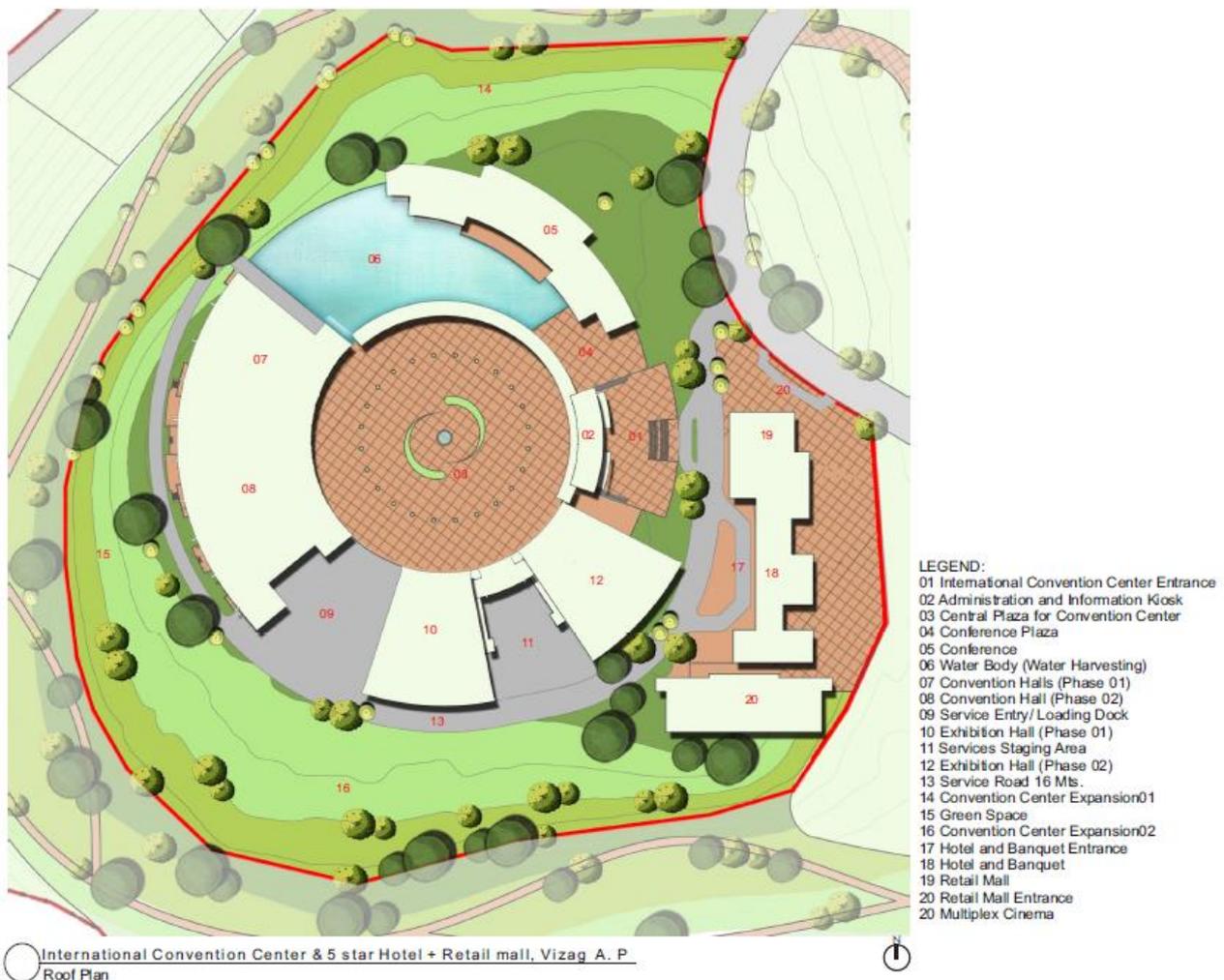
Components	Phase 1: Sizing BUA (in Sq. ft)	Phase 2: Sizing BUA (in Sq. ft)
Convention Centre	5,000 pax 125,000*	5,000 pax 125,000*
Exhibition Centre	50,000 sq. ft	50,000 sq. ft
5-Star Hotel	150 room 227,000*	100 room 152,000*
Commercial Complex	200,000 sq. ft	100,000 sq. ft

*Sizing BUA is indicative

1 Site Placement and Program Connections:

The Site is located on a steep hillside slope with expansive views towards the Sea along the East. The upper portion of the hill has a relatively flat topography that will be suitable for the development of the Convention Centre and its associated facilities.

1.1 Schematic Masterplan of Vizag Convention Centre:



1.2 Important Program Connections:

The following list of site relations and programmatic connections are necessary for the efficient operations of the Convention Centre and will lead to long term success of the project;

1. Project should be designed so that it conforms to the hillside contours and general topography of the site. This will protect the existing natural ecology of the site and also be the most efficient in terms of construction cost.
2. The Circular Plan suggested in the Schematic Masterplan takes into account the existing hill contours and further creates a strategy of creating a cohesive campus for the site with TWO primary groupings of program – Group 1 composed of Convention Centre Operations and Group 2 composed of Hotel / Retail Mall Operations.
3. The major access points for Convention Centre Drop-off and Hotel / Banquet Drop-off are adjacent to each other so that delegates can easily access either facility by crossing the road. However, note that the actual driveway entry for both is slightly off-set from one another for purpose of traffic management.
4. The Drop-off for Convention Centre comes first as this is where the primary traffic will be headed. There needs to be separate entrances for parking to each of the individual elements (Convention Halls, Exhibition Halls, Conference Rooms) and also a segregated service road that will allow service and support vehicles and personnel to access the facilities.
5. The Group 1 Facilities (Convention Halls, Exhibition Halls, Conference Rooms) are arranged around an open central urban plaza. This urban plaza is accessed from the Convention Centre Drop-off point via the Entry + Administrative Pavilion.
6. The Entry + Administrative Pavilion contains multiple kiosks for serving delegate needs such as information, check-in, announcements, lost and found, etc. It is the first point of entry into the site and will also be the first point of security screening into the overall Convention Centre Campus.
7. The Entry + Administrative Pavilion also contains the overall site Administrative offices and Campus Security Control Room from where all operations, management and security (including parking and traffic management) are handled.

8. The Urban Plaza is the primary connection element for the entire campus. From here visitors can access the various halls, conference rooms and other support facilities.
9. The Urban Plaza becomes a natural extension for connecting adjacent halls into one large gathering. Therefore, extremely large events can be easily hosted where the Convention Halls and the Exhibition Halls are connected via the Urban Plaza that will double the actual area of the halls individually. In this case, the Urban Plaza may be used for auxiliary activities such as creating information and display kiosks, setting up food courts, setting up outdoor lectures, etc. The Urban Plaza may also be covered with a temporary roof shelter and serviced with portable A/C units to truly connect and extend the functions of the adjacent halls.



10. The fact that the Urban Plaza is slightly raised from the surrounding landscape (serving as the parking podium) and is accessed from controlled points (such as the primary entry at the

Entry + Administrative Pavilion) means that it can easily be cordoned off and used as an event space accessible to registered delegates.

11. The Urban Plaza can be used independently to host outdoor events such as concerts, art / cultural events or any type of public gathering.
12. The Urban Plaza and the surrounding layout of Halls and Conference Rooms are so arranged that they offer stunning views to the sea and the surrounding landscape.
13. The Convention/ Exhibition Halls have an open triple height foyer that runs the entire length of the three halls. This Foyer will be created in a maximum of two stages concurrent with the phasing of the Convention Halls (Hall 1 + 2 in Phase 1 and Hall 3 in Phase 2).
14. The Convention/ Exhibition Hall Foyer will be the principal space from where delegates will enter the halls and associated facilities such as the meeting rooms, VIP rooms, cafe, restrooms and information kiosks.



15. The Convention/ Exhibition Hall Foyers must be designed to have maximum transparency towards the Urban Plaza using a curtain wall glass facade or similar architectural system. The Foyer must be designed to benefit from day-lighting with care for protection from glare and heat gain using a system of louvers, screens or similar that will enhance the quality of space, improve the overall architectural aesthetic and help with the overall sustainability of the space (vies and day-lighting vs. solar heat gain ratio).
16. The Convention/ Exhibition Halls must be designed so that they can be connected into one large space (accommodating approximately 5,000 people in lecture format in Phase 1). This connected space may have mezzanine levels that remain in place between the adjacent halls and also structural columns/ elements that also remain in place. However, any acoustic walls at the main ground level must be movable/ foldable so that the space is connected. The minimum height of the movable panes and the clear height below mezzanines that divide the space must be at least 4.5 mts.
17. This arrangement of creating structural supports at the edge of the mezzanine will not only create additional usable area in the larger space but will also act to drastically reduce the clear span of beams/ trusses that will support the roof system of the Convention/ Exhibition Halls.
18. The Convention/ Exhibition Halls may have day-lighting skylight or clerestory windows and will have adequate HVAC systems to comfortably accommodate the maximum design occupancy.
19. HVAC systems may be roof mounted with direct ducting into the space from above to remove the requirement of providing ground level air handling unit rooms.
20. The suggested number of restrooms and service areas in the attached plans should be a viewed as a bare minimum.
21. The Convention/ Exhibition Halls have been designed so that they offer sweeping vistas of the surrounding landscape from the top of the hillside location. The “rear” facade opposite

- the foyer should have a glazed backdrop at least 4.5 mts high. This will be incorporated with any appropriate acoustic curtain and solar shade curtain as part of the stage setting as required for events.
22. The Convention/ Exhibition Halls are located on topography that slopes down from the foyer towards the periphery. The space created under the “Ground” or main floor of the halls should be used for parking and service/ event staging. See the Masterplan for location of service road that will access this area from the lower portion of the hillside for parking and service access.
23. The masterplan calls for a minimum of 1,500 parking spaces under the created facilities of the Convention Centre / Urban Plaza.
24. The Conference Centre is located just South of the main Urban Plaza and is lined to it.
25. There is a large water body located between the Urban Plaza and the Conference Centre that serves as a rain water harvesting/ water recycling reservoir.
26. The Conference Centre is accessible by the lower portion of the Urban Plaza at the main Drop-off location.
27. The Conference Centre Central Foyer and Lobby is a double height space and must be designed to have maximum transparency towards the Urban Plaza and Water Body using a curtain wall glass facade or similar architectural system. The Foyer and Lobby must be designed to benefit from day-lighting with care for protection from glare and heat gain using a system of louvers, screens or similar that will enhance the quality of space, improve the overall architectural aesthetic and help with the overall sustainability of the space (vies and day-lighting vs. solar heat gain ratio).
28. The adjacent Conference Halls must be designed so that they can be connected into one large space. The minimum height of the movable panes and the clear height below mezzanines that divide the space must be at least 4.5 mts.

29. The Conference Halls have been designed so that they offer sweeping vistas of either the Waterbody or the surrounding landscape from the top of the hillside location. The “rear” facade opposite the foyer should have a glazed backdrop at least 4.5 mts high. This will be incorporated with any appropriate acoustic curtain and solar shade curtain as part of the stage setting as required for events.
30. The Conference Halls may have day-lighting skylight or clerestory windows and will have adequate HVAC systems to comfortably accommodate the maximum design occupancy.
31. The Conference Centre contains a cafe restaurant that will be double height and will be oriented to offer sweeping views of the surrounding landscapes and the Waterbody. It will also contain a Deck that will have a coffee shop. This deck will be located at the edge of the Waterbody and will be centrally located so that it can be privately connected to the adjacent halls for private events.
32. Note the space allocated for additional expansion of facilities to the North and South of the Convention/ Exhibition Hall areas that can be planned for future growth without affecting the existing facilities. The Masterplan has created road access, drop-off points and landscape/ plaza connections between this future expansion area and the existing facilities so create an integrated layout for the future with flexibility of planning at the later date.
33. At the current stage, these expansion areas should be treated as “Natural Hillside Habitats” and adequate tree plantation and indigenous landscape should be supported here. The space should not be used for service, parking, temporary storage, garbage dumping, workers colony, etc. The space must be protected from encroachment of any kind. The Concessionaire must connect the created “Natural Hillside Habitats” with any “Nature Trails” and landscapes in the surrounding vicinity.
34. The Group 2 Programmatic Areas will include the Hotel, Banquet facilities, Retail Mall/ Commercial Complex and Cinema Multiplex.
35. The Group 2 Programmatic Areas (Hotel, Banquet, Retail/ Commercial Mall, Multiplex

Cinema) are located at the East end of the site and have direct sweeping 270 degree views of the sea beyond the hillside. The general slope of the hillside will ensure that these views are maintained even from the hotel lobby level after any adjacent facility is built beyond the Convention Centre site.

36. The Group 2 Programmatic Areas will be designed as multi-level podium with a tower for the hotel rooms block. The podium will be stepped to follow the topography of the sloping hillside. There will be landscaped terraces that will open towards the East Side overlooking the sea beyond the hill at the Retail Mall Lobby and the Hotel Lobby level.
37. The Hotel and Banquet facilities are located on the same level and will have connection via an internal corridor along with landscape connections. The internal corridor will link the Banquet reception lobby with the Hotel Lobby.
38. The Hotel Lobby level will also contain the specialty restaurant and the Coffee Shop. These will be designed so that they open onto landscape terraces and have views of the sea towards the East and South East.



39. Primary area of the Hotel Lobby/ Coffee Shop will be double height space.
40. There must be a direct connection to the stairs / escalator leading to the Retail Mall from the Banquet Corridor. An elevator block that will go from the hotel podium upper level (restaurant, business centre, spa) to the retail mall lower level will connect the two programmatic areas. The elevators in this block will be located in separate shaft from the elevators that connect hotel lobby to the rooms and will not have access to the hotel room levels.
41. The Banquet Lobby and Halls will be double height spaces.
42. There will be specialty restaurant, business centre, gym/spa and service areas at the upper level of the Hotel Podium block. This level will have punctures that look down into the hotel lobby/ coffee shop.
43. The roof of the hotel podium will be treated as an open landscaped deck and will have the swimming pool. This roof will be contiguous with the roof of the banquet facilities. This podium landscape will also contain outdoor dining/ coffee shop and event space.
44. The Hotel Tower block is designed for 150 keys in Phase 1, however it must have the structural and MEP engineering capabilities to be extended vertically to accommodate another 100 keys at a minimum.
45. The Hotel Tower block is designed so that the maximum numbers of rooms have sea facing views.
46. The Retail/ Commercial Mall will be approached from the main approach road that is approximately 10 mts. below the approach of the Hotel Lobby entry. It will not have a vehicular entrance that opens onto the Convention Centre Drop-off road. This will help segregate traffic and lead to reduction of traffic chaos for both facilities ensuring better connectivity and flow for either facilities.

47. The Retail/ Commercial Mall will have pedestrian linkage to the Convention Centre via the Hotel.
48. The Retail/ Commercial Mall will have a central passage that will include a lobby at the entry and additional double height areas.
49. The sizes of shops / commercial establishments will vary to accommodate international scale anchor tenants and local retailers/ operators.
50. There will be multiple access points to connect the central passage to the mall terrace. The mall terrace will be landscaped to international design standards and will also allow for outdoor dining and retail kiosks. It will have sculpture points and water-bodies to enhance the environment.
51. The Cinema Multiplex will be located at the end of the central corridor to the South end of the site. It will have a “Box-Office” or ticket booth adjacent to the entry both at the central corridor and also at the mall terrace. A common lobby will link both ticket booths and also provide access to concession stands and restrooms.
52. Entry into the cinemas will be from the main lobby at the lower level of the multiplex.
53. Exit from the cinemas will be at the upper level into the mall central corridor upper level. There will no exit to exterior except to mall terrace for fire exit.
54. There will be parking located under the retail mall on two levels. This will extend to the full extent of the site allocated and create approximately 1,500 cars. The hillside slope creates a significant elevation change and the foundations for the mall/ hotel podium will need to be created with open crawlspace below. This space will be utilized for the parking.



2. Project Phase Development:

There are a few key elements that must be adhered to while planning the Phasing of the project.

1. Facilities that will be expanded should be planned so that construction activities on later phase expansions will not disturb the operations of the existing facilities.
2. Structural supports and MEP connections that will expand to the new facilities may be embedded in the initial phase at the “line of expansion” so that there is minimum disturbance and maximum efficiency in construction.
3. Ground/ Plinth area for Phase 2 expansion areas may be partially prepared and used for auxiliary facilities. This preparation may be as simple as creating a level site with compacted soil basic PCC topping. Auxiliary use for this space may be for parking, event services staging (space for carpenters to create kiosks/ space for catering kitchens), etc.
4. If not needed for auxiliary facilities, the area will be maintained as a garden with smaller shrubs and ground cover rather than slow growing trees.
5. As noted earlier, the areas of Convention Centre marked for Future Expansion (beyond Phase 2) will be maintained as a “Natural Hillside Habitat”.

3. Disaster Management Strategy:

In general, the entire site and all buildings, service facilities and auxiliary services must be designed to the highest level of fire safety, earthquake resistance, wind/ typhoon resistance that is mandated by the local Municipal Authorities. The emergency response systems must be checked annually and certified by the local Fire Brigade Authority or the competent government officer.

3.1 Objectives:

To create and implement a well-coordinated and strongly connected disaster prevention and management system. A campus becomes disaster resilient when it meets the following criteria:

- It is prepared with systems and response plans in place prior to any calamity and has trained with the relevant government and not-government responders for the possible eventuality
- Responds effectively in real time to move people out of harm's way
- Meets resident user's needs in a crisis environment
- Protects assets (human safety and movable / immovable property)
- It's policies not only resist and prevent disasters without failing, but are mandates to look beyond to a future of sustainable development

3.2 Specifications

A Disaster management team will be part of the Convention Centre Administration which will encompass authorities from all major government, civic bodies and non-government organizations who work at the local grass-root level and hence are constantly in touch with the area and its dynamics.

Disaster resilience integrates research and scientific knowledge gained from “disaster laboratories” with emerging technologies and the community’s political process to adopt realistic public policies based on the following four pillars:

- Preparedness
- Projection
- Emergency Response
- Recovery

1. Preparedness:

At all times the campus should be prepared for tackling an impending or foreseeable disaster. This includes assessment of hazards, vulnerability to calamities and risk assessments. The Command and Control Centre at the Entry Pavilion to create a template for predictions, warning and coordinated departmental response which must be updated every THREE years or sooner based on risk assessment. These “Disaster Planning Scenarios” will be practiced through drills and training exercises involving the multiple agencies at least annually.

The following quote is pertinent to the idea of preparedness.

“This is the first and foremost lesson learned from the death and devastation caused by our country’s most destructive natural disaster: No matter how prepared we think we are, we must work every day to improve.”

Frances Fragos Townsend - Assistant to the President for Homeland Security and Counter terrorism, U.S.A

2. Protection

'Disasters are not natural.' While they can be triggered by 'Natural' events such as heavy rains or “Human Induced' elements such as Climate Change or Riots, it is poor protection planning and implementation in populated areas that cause the Disaster. For protection from disasters, the following systems are mandatory;

- Information on risk awareness and institutional capacity must be made available on the Convention Centre Website and Visitor Centre Bulletin Boards. This will include information for users directing them to appropriate shelters, community centers or hospitals / medical facilities based on the situation. It will also list recommendations and standards for safety and disaster mitigating that individual buildings must follow.
- Implementation of building codes and lifeline standards is essential. Unplanned urban growth must be immediately checked and all buildings constructed must adhere to applicable government construction standards. Such unplanned growth can have drastic consequences on sanitation / disease propagation, soil erosion, flood control, forest fires and other debilitating factors that cause life safety and property damage issues.
- Designing infrastructure and buildings while incorporating passive energy design features and site specific architectural features will help the building consume lower energy and also make it

more resilient to any calamity.

- Setting performance standards and maintenance thresholds for essential facilities (hospitals, fire-stations, etc.) and critical facilities (power grid, water grid, etc.) is instrumental in being prepared and protected from a disaster, especially as these public facilities will cater to the overall public.
- Public Use Cultural / Social / Sports facilities must be designed with Dual Purpose from the initial step. Other than its primary purpose as a school, community centre, stadium, parking garage, etc. the Convention Centre Operators and Administration along with their architects/consultants must keep in mind the requirement to function as a Disaster Management Shelter that it may have to temporarily fulfill. This Shelter may be used for local/ city residents that will be housed here in case of a larger regional disaster.
- Protection of Natural Eco-System (Hill Slopes, Watershed and Forests) via the Urban Aqua Forest is essential.

3. Emergency response

The plan for emergency response will be practiced through regular drills conforming to procedures created for the Convention Centre.

- **Established Procedures:** The Command and Control Centre along with the Municipal Authorities will create procedures that relate to likely calamities (Fire, Earthquake, Flood, Building Collapse, Landslide, Terrorist Action, Riot, etc.) that will involve all 4 Aspects of Disaster Management. At the necessary scales there will be plans that include augmented assistance from regional centers such as the Municipal Government / Vishakhapatnam Collector's Office.
- **Evacuation Routes:** Marking evacuation routes for fire and flood may be in opposite directions. Therefore, a system must be in place for localized scenarios for marking evacuation routes that the general occupants can follow is essential. Interactive Street Signs are an essential component in this strategy, however redundant and backup systems must be considered, planned and practiced.
- **Emergency Medical Care:** Based on the scale and nature of the calamity, the local health care facilities may be pressed into service. Further, additional temporary shelters (stadium, community centre, etc.) may also be pressed into service.

- **Search And Rescue:** The preparation and execution of first responders at a disaster scene is the single most critical aspect in saving life. This is true for all types of emergency situations from fire to flood, building collapse, etc. Training and Communication are critical aspects in providing actionable knowledge and coordinated efforts for life safety efforts.
- **Emergency Transportation:** The ability to effectively handle transportation is critical in times of emergency; Mobility of first responders, medical evacuations and other service providers will not be effective if the overall traffic is stuck due to inadequate and ineffective traffic management.
- **Local, Regional, And International Assistance:** Coordination of the Disaster Response must be at the local level at the Command and Control Centre. This may integrate efforts with regional and international teams, however local decision making (based on established procedures) is critical. The Command and Control Centre will be the logistical and communication hub local municipal authorities for a coordinated disaster management effort.

4. Recovery

The Recovery Efforts will focus on resumption of everyday activities and strengthening procedures for future disaster mitigation. This effort includes;

- **Post-Disaster Studies:** A comprehensive survey of the disaster along with risk assessment and response analysis needs to be carried out by both the Command and Control Centre and an independent agency / consultant. The effort needs to look for weak links in the overall disaster management strategy and fortify it against future calamities. This effort will include strategies for improving infrastructure / utility grids, building construction standards and occupancy codes, building fire codes, emergency response procedures, ICT systems, etc.
- **Methodical Reconstruction:** Will be initiated by both private building owners and also the Municipal Government depending on the property or facility affected. Effort during reconstruction will focus on resuming normalcy as soon as possible, however the root cause of building/infrastructure failure needs to be rectified or fortified to protect against future calamities.
- **Strengthening Of Building Codes:** In case any recommendations are made for building / fire codes the responsible Municipal Authority / INCAP must initiate steps to incorporate those code revisions and all future building's must adhere to these revised building codes.

- **Business Resumption:** Getting businesses up and running at the earliest needs to be high priority for urban normalcy. This involves ensuring transportation links and utilities are functional at the earliest. The respective agencies need to create resumption priorities for these infrastructure elements as soon as health safety issues have stabilized and critical facilities are operational.
- **Insurance:** Disasters give fresh perspective to individual residents, property owners and civic authorities on the appropriate insurance coverage. However, in case of large scale damage, the local / state government may have to intervene to ensure that coverage expenses are not inordinately raised and are at a justified level.
- **Training:** Lessons learnt by first responders, including residents and government / municipal personnel, need to be cataloged by the Command and Control Centre. These lessons will then be analyzed by the various officers and consultants with the purpose of revising and upgrading the training procedures at the individual building scale and the urban scale.

3.3 Command and Control Centre:

The Authority acting through the Command and Control Centre (CCR) will update all procedures and evaluate equipment, technologies and systems to determine current effectiveness and potential requirements for the future.

The Command And Control Centre which will serve as the headquarters for preventing criminal activity, chaos, disease and calamities, and if the need arises, controlling and addressing the disaster by coordinating efforts between various organizations.

Specifications

- Ideally the CCR will be located within the Entry Pavilion in the Convention Centre area.
- Security cameras will be installed at regular intervals all over the site that will send a direct feed to the CCR which will be closely monitored 24/7.
- The cameras will be smart security cameras with inbuilt guidelines and the capacity to recognize deviation from these guidelines, flag them and intimate the CCR. To cite examples; parking violations, traffic violations, water logging, accumulation of trash, indication of an impending natural calamity, suspicious activity, theft and other illegal activities.
- Inside the CCR, any issue that is likely to disrupt normal and safe functioning of the area as

intimated by the camera or observed through the feed, will trigger prompt and appropriate action. Relevant authorities will be informed, and a course of action will be devised and then monitored to prevent the damage and/or curb an impending disaster. For example; in case major water logging is observed in a specific area; the traffic authorities of that area will be intimated to guide affected traffic, the nearby hospital will be alerted with updated information so as to be ready for cases of injury or water borne infections, the public and water works department will be intimated to drain the water and any other affected department will be apprised of the situation.

Potential Technologies & Strategies

The Command And Control Centre leadership will be composed of the Authority and Local Administration Officers. It will include the Municipal Fire Control Officer and the head of the regional Police Authority.

The Command and Control Centre Smart may consider advanced systems such as;

- Sophisticated surveillance cameras with security software
- Infrastructure systems connected to weather sensors via software
- Event Management and Traffic Control Software

3.4 Temporary Community Centre:

The Convention Centre will be equipped to act as a self sufficient shelter for city occupants in case of a declared government disaster. In this case, the normal operations will be suspended for the duration of the disaster and the facility will potentially be used for occupants and city/ regional residents shelter services. The Centre will be at all times prepared for an emergency/ disaster response where it can address such a situation promptly with least dependence on outside sources. Such preparedness is crucial in avoiding loss to life and property.

Specifications

- An emergency panel has to be in place inclusive of a representative of the police department, the fire department, a doctor, and Convention Centre administrator.
- A response plan to be drafted for situations of seasonal variations like floods, droughts, fire, seasonal illnesses etc.

- Disaster response drills should be conducted by all relevant entities, so citizens are not caught off guard and are prepared to react appropriately if such a situation arises.
- The Shelter should have an independent solar generated power source
- Have a water purification system that partially runs on alternate power sources
- Refrigeration system that partially runs on alternate power sources
- Sufficient stock of medicines and food (supplied by Municipal Authorities for city/ regional residents)
- Capability to provide basic lighting that partially runs on alternate power sources
- Reliable, disaster proof communication with the CCR
- On-site Renewal Energy Generation (Solar / Wind)

3.5 Means of Egress

The means of egress design requirements for the building shall meet the following requirements.

- In buildings that are protected throughout by an automatic sprinkler system, 1-hour minimum fire rated corridors shall be required.
- In buildings without automatic sprinkler system, 2-hour minimum fire rated corridors shall be required.
- Interlocking (scissor) stairs shall count as only one exit stair. A minimum of two exit stairs are required for any multi-story building.
- Fire escapes shall not be considered approved exits.

Stairway Ventilation:

In construction projects having occupied floors located more than 24 mts above the level of exit discharge or more than 9 mts below the level of exit discharge, exit stairways shall be ventilated to the exterior in accordance with locally applicable building codes.

Photo-luminescent Materials

Exit Stair Identification Signs:

- Exit Stair identification signs shall have a photo-luminescent background complying with Standard Specification for Photo-luminescent (Phosphorescent) Safety Markings as a minimum standard.
- The signs shall be a minimum size of 457 mm (18 inches) by 305 (12 inches).
- The letters designating the identification of the stair enclosure shall be a minimum of 38 mm (1 1/2 inches) in height.
- The number designating the floor level shall be a minimum of 127 mm (5 inches) in height and located in the centre of the sign.
- All other lettering and numbers shall be a minimum of 25 mm (1 inch) in height.
- The directional arrow shall be a minimum of 305 (12 inches) in length.

Exit Stair Treads:

- Exit Stair treads shall incorporate a photo-luminescent stripe that is either an applied coating, or a material integral with, the full width of the horizontal leading edge of each stair tread, including the horizontal leading edge of each landing nosing.
- The width of the photo-luminescent stripe shall be between 25 mm (1 inch) and 51 mm (2 inches).
- The width of the photo-luminescent stripe, measured horizontally from the leading edge of the nosing shall be consistent at all nosings.

3.6 Fire Alarm Systems

- All fire alarm systems shall be addressable systems (ability to transmit instructions from building security and / or Control Centre to affected space).
- All fire alarm systems installed in buildings shall be an emergency voice/alarm communication system when any one of the following conditions exists:
 - The building is 2 or more stories in height above the level of exit discharge.
 - The total calculated occupant load of the building is 300 or more occupants.
 - The building is subject to 100 or more occupants above or below the level of exit discharge.
- The emergency voice/alarm communication system shall provide an automatic response to the receipt of a signal indicative of a fire emergency. Manual control with the capability of making live voice announcements shall also be furnished to provide occupants notification either on a selective or all-call basis.
- With the exception of mass notification, fire alarm systems shall not be integrated with other building systems such as building automation, energy management, etc.
- Fire alarm systems shall be self-contained, stand alone systems able to function independently of other building systems.
- All emergency voice/alarm communication systems shall be installed within a room separated from the remainder of the building by not less than a 1-hour fire resistance rated fire barrier.
- Each fire alarm system shall be provided with an electrical UPS to protect the fire alarm system from electrical surges, spikes, sags, over-voltages, brownouts, and electrical noise. The UPS shall be U.L. listed and shall have built in overload protection.
- All fire alarm signals (i.e., alarm, supervisory, and trouble signals) shall be automatically transmitted via a digital alarm communicator over leased phone lines to a U.L. listed Control Centre.
- All fire alarm system wiring shall be solid copper and installed in conduit. Stranded wiring shall not be used.
- Conduit shall be rigid metal or electrical metallic tubing, with a minimum inside diameter of 19 mm (3/4 inch) that utilizes compression type fittings and couplings.

3.7 Manual Fire Alarm Boxes

- Manual fire alarm boxes shall be installed in every new construction project with adequate spacing and accessible locations.
- Manual fire alarm boxes shall be double-action stations.
- Manual fire alarm boxes shall be of contrasting color to the background on which they are mounted and preferably in “Fire Engine” Red Color.

3.8 Water-flow Switches

- A water-flow switch shall be provided for each floor or fire area protected by sprinkler systems.
- Each water-flow switch shall be separately annunciated at the main fire alarm control unit and all required annunciators.

3.9 Smoke Detectors

- Area smoke detectors shall not be installed in each of the following rooms: mechanical equipment, electrical closet, telephone closet, emergency generator room, un-interruptible power service and battery rooms, and other similar rooms.
- Smoke detection appropriate for the application shall be installed in each of the following rooms: electrical switch gear, transformer vaults and telephone exchanges (PABX).

3.10 Audible Notification Appliances

- To ensure audible signals are clearly heard, the sound level shall be at least 70 dBA throughout the residential / office space, general building areas and corridors measured 1524 mm (5 feet) above the floor. The sound level in other areas shall be at least 15 dBA above the average sound level or 5 dBA above any noise source lasting 60 seconds or longer.
- The design for achieving the required minimum dBA levels shall take into consideration all building construction materials such as carpeting, hard surfaces, walls, doors, etc., and any other materials that can cause sound level attenuation and/or clarity problems in the placement and location of all audible notification appliances.
- Where emergency voice/alarm communication systems are provided, fire alarm speakers shall be installed in elevator cars and exit stairways; however they shall only be activated to broadcast live voice messages (e.g., manual announcements only). The automatic voice messages shall be broadcast through the fire alarm speakers on the appropriate floors, but not in stairs or elevator cars.

3.11 Visible Notification Appliances

- Visible notification appliances shall only be installed in projects that involve the installation of new fire alarm systems.
- Visible notification appliances shall only be required to be installed in public and common areas. Public and common areas include public rest rooms, reception areas, building core areas, conference rooms, open office areas, etc. For the purposes of this requirement, visible notification appliances shall not be required to be installed in individual residences or offices.
- Visual notification appliance circuits shall have a minimum of 25 percent spare capacity.
- Visible notification appliances shall not be installed in exit enclosures (i.e., exit stairs, etc.).

3.12 Fire Alarm Messages for High Rise Occupancies

Upon receipt of any fire alarm signal, the fire alarm system shall automatically activate a distinctive three-pulse temporal whoop pattern for three (3) cycles followed by the specified automatic voice messages which shall be repeated until the control panel is reset or until overridden by manually activated live voice messages.

The automatic voice messages shall be broadcast through the fire alarm speakers on the specified floors, but not in exit stairs or elevator cars. However, the capability to transmit voice messages to elevator cars and exit stairs shall be included, but be manual only.

The “**Fire Zone**” message shall be broadcast through speakers on the floor of alarm origin, the floor immediately above the floor of origin, and the floor immediately below the floor of origin. In addition, the visible alarm notification appliance circuit(s) shall be activated on the floor of alarm origin, the floor immediately above the floor of origin, and one floor immediately below the floor of origin. A first floor alarm shall transmit a “Fire Zone” message to all below grade levels.

The “**Safe Area Zone**” message shall simultaneously be broadcast to all other building floors. However, the visible alarm notification appliance circuit(s) shall not be activated on these floors. The “Safe Area Zone” message shall activate for two complete rounds and silence automatically. After five minutes, if the system is still in an alarm condition, the “Safe Area Zone” message shall automatically start and activate for two complete rounds and silence again. This sequence shall be repeated until the fire alarm system is reset. In the event a subsequent fire alarm is received at the fire alarm control panel by a floor that was previously receiving a “Safe Area Zone” message, this floor shall automatically revert to perform the actions for a “Fire Zone” message.

A live voice message shall override the automatic output through use of a microphone input at the main fire command centre. When using the microphone, live messages shall be broadcast through

speakers in stairwells, in elevator cars, and throughout the selected floor or floors. Each stairwell shall have its own dedicated speaker zone and speaker zone activation switch. Each elevator bank shall have its own dedicated speaker zone and speaker zone activation switch. An “All Call” switch shall be provided which activates all speakers in the building simultaneously.

Messages shall be digitized voice and utilize a professional quality male voice and shall be as follows:

- **“Fire Zone” Message:** “May I have your attention, please? May I have your attention, please? A fire has been reported which may affect your floor. Please walk to the nearest exit and leave the building. Please do not use the elevators.”
- **“Safe Area Zone” Message:** “May I have your attention, please? May I have your attention, please? A fire has been reported in another area of the building. You are in a safe area. Please stay in your work area and await further instructions. Please do not use the elevators.”

Note: Messages need to be translated into Hindi and Telugu for broadcast and all three, including English message, need to be looped during playback.

4 Security Planning

4.1 Site Planning and Landscape Design:

- Effective site planning and landscape design has enhanced the security of the Vizag Convention Centre and eliminated the need for some engineering solutions. Security consideration has been an integral part of all site planning, perimeter definition, lighting and landscape decisions.

4.2 Access Control and Electronic Security:

- Electronic security, including surveillance, intrusion detection, and screening, is a key element of facility protection. These criteria primarily address access control planning; including aspects of stair and lobby design, because access control must be considered when design concepts for a building are first conceived. Designs should be flexible to accommodate future access control objectives.

4.3 Perimeter Protection Zone:

- Site perimeter barriers are one element of the perimeter protection zone. Perimeter barriers capable of stopping vehicles of 2 Tons, up to a speed of 10 Km/h, shall be installed. A vehicle velocity shall be used considering the angle of incidence in conjunction with the distance between the perimeter and the point at which a vehicle would likely be able to start a run at the perimeter. A barrier shall be selected that will stop the threat vehicle.
- Refer to Vizag Convention Centre Masterplan Layout for sizes and placement of various types and designs of buffers and barriers such as walls, fences, trenches, ponds and water basins, plantings, trees, static barriers, sculpture, and street furniture.
- Refer to Vizag Convention Centre Masterplan Layout for site circulation and approach that prevents high speed approaches by vehicles.

4.4 Effective Site Lighting Levels:

- At vehicular and pedestrian entrances, horizontal maintained foot candles; and for perimeter and vehicular and pedestrian circulation areas, horizontal maintained foot candles.
- Perimeter lighting will be continuous and on both sides of the perimeter barriers, with minimal hot and cold spots and sufficient to support CCTV and other surveillance.
- For safety reasons and for issues related to camera technology, lower light levels may be desirable. Site lighting levels should be coordinated with CCTV system requirements.

4.5 Site Signage:

- Confusion over site circulation, parking, and entrance locations can contribute to a loss of

site security. Signs are provided off site and at entrances; there are on-site directional, parking, and cautionary signs for visitors, employees, service vehicles, and pedestrians.

- Unless required by other standards, signs should generally not be provided that identify sensitive or high security areas.

4.6 Landscaping

- Landscaping design elements that are attractive and welcoming can enhance security. For example, plants can deter unwanted entry; ponds and fountains can block vehicle access; and site grading can also limit access.
- Avoid landscaping that permits concealment of criminals or obstructs the view of security personnel and CCTV, in accordance with accepted security principles.



5 Architecture and Interior Design Security Planning:

5.1 Mixed Occupancies:

- When possible, high-risk tenants should not be housed with low-risk tenants. If they are housed together, publicly accessible areas should be separated from high-risk tenants.

5.2 Public Toilets and Service Areas:

- Public toilets, service spaces, or access to vertical circulation systems should not be located in any non-secure areas, including the queuing area before screening at the public entrance/public plaza.

5.3 Loading Docks and Shipping and Receiving Areas:

- Loading Docks and Shipping and Receiving Areas should be separated by a specified distance in any direction from critical utilities and services. The recommended distance is 15 mts or located on a separate level with security clearance for access to the main space.

5.4 Retail in the Lobby:

- Retail and other mixed uses, create public buildings that are open and inviting. While important to the public nature of the buildings, the presence of retail and other mixed uses may present a risk to the building and its occupants and should have an independent access. People entering the building from retail areas should have to pass through a security screening station prior to gaining access to the building.
- Retail and mixed uses may be accommodated through such means as separating entryways, controlling access, and hardening shared partitions, as well as through special security operational countermeasures for high security program areas.

5.5 Stairwells:

- Stairwells required for emergency egress should be located as remotely as possible from areas where blast events might occur.
- Wherever possible, stairs should not discharge into unsecured areas of lobbies, parking, or loading areas. In this instance, the stair should be equipped with an automatic door closer that only permits operation from the interior and does not allow access from the outside at that point.

5.6 Mail-room:

- The mail-room should be located away from facility main entrances, areas containing critical services, utilities, distribution systems, and important assets.

5.7 Lobby Doors and Partitions:

- Doors and walls along the line of security screening should meet adequate explosive blast and 2 hour fire protection requirements.

5.8 Parking Security:

- Parking restrictions help keep threats away from a building. Mitigating the risks associated with parking requires creative design and planning measures, including parking restrictions, perimeter buffer zones, barriers, structural hardening, and other architectural and engineering solutions.
- All cars entering the secure plot areas will go through security checks at the vehicular entry points. These points are divided into staff, visitor and service entry lanes to provide escalated security screening if necessary. Commercial / hotel facilities may elect to provide a secondary vehicular screening at their plot threshold.
- For all parking facilities, maximizing visibility across as well as into and out of the parking facility shall be a key design principle.
- The preferred parking facility design employs express or non-parking ramps, speeding the user to parking on flat surfaces.
- Pedestrian paths should be planned to concentrate activity to the extent possible. For example, bringing all pedestrians through one portal rather than allowing them to disperse to numerous access points improves the ability to see and be seen by other users. Likewise, limiting vehicular entry/exits to a minimum number of locations is beneficial.
- Long span construction and high ceilings create an effect of openness and aid in lighting the facility. Shear walls should be avoided, especially near turning bays and pedestrian travel paths. Where shear walls are required, large holes in shear walls can help to improve visibility. Openness to the exterior should be maximized. Screens may be provided to prevent light pollution to adjacent areas.
- It is important to eliminate dead-end parking areas, as well as nooks and crannies. Landscaping should be done judiciously so as not to provide hiding places. It is desirable to hold planting away from the facility to permit observation of intruders.
- Stairways and elevator lobby design shall be as open as local codes permit. The ideal solution is a stair and/or elevator waiting area totally open to the exterior and/or the parking areas. Designs that ensure that people using these areas can be easily seen - and can see out - should be encouraged.
- If a stair must be enclosed for code or weather protection purposes, glass walls will deter both personal injury attacks and various types of vandalism. Potential hiding places below stairs should be closed off; nooks and crannies should be avoided.

- Elevator cabs should have glass backs whenever possible. Elevator lobbies should be well-lighted and visible to both patrons in the parking areas and the public out on the street.
- Parking Garage interior walls should be painted a light color (i.e., white or light blue) to improve illumination.
- Signage should be clear to avoid confusion and direct users to their destination efficiently.

5.9 Parking on Adjacent Streets:

- Parking is not permitted on curb lanes, with a sidewalk between the curb lane and the building. There are clearly marked drop-off and pick-up zones along curbs where no parking is permitted. These have sufficient setbacks from the building edges.
- Where distance from the building to the nearest curb provides insufficient setback, and compensating design measures do not sufficiently protect the building from the assessed threat, parking in the curb lane shall be restricted by using site structural features (concrete plant boxes etc.) to prevent parking.

6 Emergency Power Generation:

- Emergency Generators, running on liquid fuel sources are generally not permissible for individual clients (retail tenants, etc.) to prevent security risks when transporting and storing fuel into the site.
- The emergency generator should be located away from loading docks and service entrances. More secure locations include the roof, protected grade level, and protected interior areas. The generator should not be located in any areas that are prone to flooding.
- It is highly recommended that a non-fuel based system; such as a battery supported inverter system is used instead. This should be augmented with a solar photo-voltaic array for extended power supply.

6.1 Normal Fuel Storage:

- Access should be restricted and protected (e.g., locks on caps and seals).
- The fuel tank for power backup systems should be mounted near the generator, given the same protection as the generator and sized to store approximately 24 hours of fuel. A battery and/or UPS could serve a smaller building or facility.

6.2 Tertiary Power:

- Conduit and line can be installed outside to allow a trailer-mounted generator to connect to the building's electrical system, if temporary tertiary power is required for specific events.

7 Landscape and Topography

The Vizag Convention Centre needs to have world class landscape as a means for creating a facility that will be a true asset for the city of Vishakhapatnam and the state of Andhra Pradesh. Landscape offers the easiest and most cost effective strategy for improvements of the site and the overall ambiance of the area.

The Vizag Convention Centre will need to have detailed planning for landscaping;

- Approach and Service Roads, including sidewalk planters and medians
- Drop-off Zones and Traffic Islands
- Entry Plazas (with appropriate hardscape featuring fountains, sculptures, planters)
- Gardens and Green Areas
- Public Plazas and Terraces (with appropriate hardscape featuring fountains, sculptures, planters) and including associated features such as shaded walkways, pergolas, elevated decks, etc.



7.1 Xeriscape Principals

Objectives

The Vizag Convention Centre site needs to be designed to limit or eliminate the use of potable water or subsurface water resources available on the project site for landscape irrigation by employing a Water Harvesting system that includes Grey-water recycling for irrigation. To augment this effort the landscape will use resource efficient landscape strategies as described here. Xeriscape is the concept of using drought tolerant and low water consumption plants and landscape strategies that are endemic to the region. They will therefore be part of the local eco-system and help support the local ecology and will also be adapted to the local climate requirement less maintenance.

Specifications

Reduce potable water consumption for irrigation by employing the following items:

- Use local drought resistant and hardy plant species or Xeriscape landscape.
- Irrigation efficiency with the use of drip irrigation for trees instead of flood irrigation.
- Use only captured rainwater / recycled Grey-water treated and conveyed for landscape and irrigation purposes.
- Perform a soil/climate analysis to determine appropriate landscape types and design the landscape with indigenous plants to reduce or eliminate irrigation requirements.
- Install landscaping that does not require permanent irrigation systems.

7.2 Hillside Preservation and Drainage Strategy:

Objectives

A clear hillside preservation and drainage strategy will help avoid soil erosion and at the same time lend itself to flood prevention. It would involve planting trees and creating holding tanks on the hillside which would in addition to the above listed benefits also create a recreational landscape and prevent encroachment on that land.

Specifications

- Create an aqua urban forest: plan the hillside with trees and multiple flood water holding tanks.
- The flood water holding tanks by containing excess water would help in reducing the volume of water that feeds into the storm drains thereby reducing the load on the storm water drainage system and increasing the efficiency of the same.
- A controlled release system should be built into the holding tanks so water can be released into

the storm water drains when they are ready for more water.

- The root of the trees would arrest the soil and prevent soil erosion and would also slow the movement of the water.
- The unlined flood water holding tanks would also help replenish ground water.

Potential Technologies & Strategies

- Plant trees that have been proven most effective in arresting soil and preventing erosion.
- The size and number of flood water holding tanks should be based on an empirical study of the requirement of the area.
- Controlled release system for the water tanks



8 Architectural Character Principals:

The visible façades of buildings are a significant component of the “first impression” and “sense of place” of a site. Buildings form visual gateways, edges and backgrounds; their architectural elements and choice of building materials create visual character and interest; and their scale or massing contributes to the “quality” experienced by visitors and passers-by. Overall site design and specific building details need to be integrated to present a unique, inviting and memorable place.

The overall objectives of the Vizag Convention Centre Design Guidelines applied to Architectural Character are;

1. Set overall Setback and Volumetric Massing standards for architectural elements based on the supplied Schematic Masterplan.
2. Encourage innovative and efficiently designed buildings that are consistent with sustainable development.
3. Promote spatial interplay and material texture to engage the façade characteristics of the architecture with the streetscape and to create a rhythmic interaction between the façade and the landscape.
4. Create an urban environment with a harmonious “sense of place” that unites the entire area with basic parameters of façade texture, scale, material, landscape and mass/void but without restricting diversity of architecture expression and compromising on user functionality. This can most clearly be seen in the design of the Urban Plaza and Terraces of the Vizag Convention Centre.
5. Establish the basic principles of movement from the site streets and landscape areas into the individual plot and leading into the public areas of the building.
6. Establish minimum design standards and controls on common exterior elements of the project including the boundary walls, the entrances/ driveways and common landscape areas.

Site design and building form refer to the arrangement of buildings, space and landscape

within a site. They involve a careful consideration of building scale and form, movement patterns, and external spaces. The interrelationships between these, rather than their individual characteristics, will largely determine the effectiveness of the design. In addressing these issues, new development should achieve the highest architectural standards possible.



9 Energy Reduction and Generation:

Objectives

Achieve enhanced energy efficiency by reduced energy use and creating optimum conditions for the use of passive and active solar strategies. Encourage on-site renewable energy supply to reduce environmental and economic impacts associated with fossil fuel energy use.

Benefits include greater security and self sufficiency, lower operating costs, reduced maintenance improved occupant productivity and positive impact on the environment.

Specifications

- The Vizag Convention Centre should aim for at least 25% of peak power consumption to be generated on-site using solar PV arrays. This peak power will amortize the energy consumption of the Convention Centre events over 365 days rather than take a peak daily reading.
- Vizag Convention Centre HVAC system must be designed so that it will provide the most energy efficient operations. The system must be broken into modular zones that will be controlled for operations when single or multiple halls are in operation for energy efficiency.
- The Vizag Convention Centre Security Grid, including the CCTV system, will be powered primarily on a Solar Photo-voltaic charged battery system. This will include a larger capacity solar array for the Control Centre. Grid power will serve as emergency backup.
- Vizag Convention Centre lighting, including landscape and street lighting will be Solar Powered LED lighting systems.
- All Individual buildings (convention, commercial, hospitality or facilities, etc.) will use at least 75% of site and landscape lighting using solar powered LED lighting.
- No incandescent or halogen or other energy intensive bulbs are permitted for interior lighting; CFL or LED must be used for all interior lighting.
- All multistory buildings will have a large capacity roof mounted Photo-voltaic solar array that will tie into the power grid for use by respective services and infrastructure. This includes use of pumps for irrigation use and waterscape.
- At least 75% of all Vizag Convention Centre service and security vehicles will be electric powered. There will be service/security vehicle electric charging stations at all Parking Garages and service buildings.
- No fuel operated (petrol, diesel, etc.) tools or appliances will be permitted for routine landscape maintenance. This includes lawn mowing, hedge/tree trimming, spraying or leaf blowing tools. All such tools must be either manually operated or corded/battery operated electric tools. An exception will be made for one time improvements that include large excavation etc. operations to establish landscape areas.

Potential Technologies & Strategies

Stakeholders are encouraged to use electric vehicles and tools for service needs and local transport. Use efficient LED lighting systems for external and internal lighting and employ high-tech automated Building Management Systems for energy efficiency.

10 Water Conservation and Rainwater Harvesting:

Objectives

Minimize impact on municipal water supply by taking advantage of the seasonal monsoon rainfall on the site in creating an efficient rainwater harvesting system.

Specifications

- The Rain Water Harvesting System is fed by Convention Centre storm water in the rooftops of the facilities and the plaza / promenade drains that lead to collection/ settlement ponds. The water goes through a natural filtration process at this point and is pumped into series of ponds and cascades, that further cleanse, scrub and aerate the water.
- As water is lost in the Harvesting Ponds due to evaporation or irrigation, it is replenished from the collection pond. During dry seasons, the collection pond receives recycled Grey-water from the Sewage Treatment Plant.
- Individual buildings at the Convention Centre site are highly encouraged to create on-site water harvesting systems that tie into rain water and the Grey-water in their buildings.

Potential Technologies & Strategies

Use Solar powered pumps for lifting the water to the required ponds and for operating any required filtration equipment. Use non-chemical or natural bio-filtration plants for cleansing the harvested rainwater.



10.1 Water Use Reduction:

Objectives

Maximize water efficiency within all Convention Centre buildings and site works, including landscape, to reduce the burden on municipal water supply and waste water systems.

Specifications

- **Building Water Efficiency**

Employ strategies that in aggregate use 20% less water than the baseline calculated for the building (not including irrigation) based on local codes and standards. Calculations are based on estimated occupant usage and include the following fixtures (as applicable to the building): water closets, urinals, lavatory faucets, showers and kitchen sinks.

The following specifications must be used for plumbing fixtures;

The average flow rate for all lavatory faucets must be ≤ 7.0 Liters/minute

The average flow rate for all shower heads must be ≤ 7.0 Liters/minute

The average flow rate for all toilets, including dual-flush toilets, must be ≤ 6 Liters/flush

- **Landscape Efficiency**

For irrigation, use only harvested rainwater or recycled waste water/ gray water. Use Xeriscape landscape practice techniques (drought resistant, adapted to the local environment and non-invasive, low maintenance plant species.) Install landscaping that does not require permanent irrigation systems such as extensive grass lawns, etc.

Potential Technologies & Strategies

Use high-efficiency fixtures, dry fixtures such as composting toilet systems and non-water using urinals to reduce the potable water demand.

Consider the use of automatic flow faucets and flush systems to promote water usage efficiencies.

Consider the use of drip irrigation techniques for mature trees and hedge elements rather than flood or sprayed irrigation techniques.

10.2 Innovative Waste Water Technologies

Objectives

Reduce generation of waste water and potable water demand, while increasing the local aquifer recharge.

Augment rainwater harvesting system with non-potable water recycled from Grey-water.

Minimize water use for landscape by utilizing post consumer recycled Grey-water and

harvested rain water for irrigation and site waterscape.

Specifications

- Reduce potable water use for building sewage conveyance by 20% through the use of water-conserving fixtures (water closets, dry urinals, etc.) This must be implemented at all buildings. Occupancy Certificate and connections of utilities must not be made until the use of water-conserving fixtures is certified by Government appointed building inspector.
- Design building sewage system with separate lines for sewage (from Water-Closets) and Grey-water (from sinks, showers, cloth washing, etc.). Grey water can be processed on-site and recycled for irrigation and other non potable uses such as toilet flushing.

Potential Technologies & Strategies

- Specify high-efficiency fixtures and dry fixtures such as composting toilet systems and non-water using urinals to reduce waste water volumes in commercial areas.
- Options for on-site waste water treatment include packaged biological nutrient removal systems and high-efficiency filtration systems.
- Create an “Aqua Forest” as detailed in this Guidelines Handbook in the areas surrounding the site to promote better storm water management, increase ground water recharge and also create a natural bio-reserve in the area.