The Proposed National Paediatric Hospital.

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Section 1.

Introduction:

The basis of this paper is to express serious concerns with the design of the proposed new children's hospital, in particular the designs impact on health and safety issues. To understand the basis these concerns I will explain the nature of the work undertaken by Manus Coffey & Associates Ltd.

Manus Coffey & Associates is the largest firm of forensic engineering consultants in Ireland. The company employs nine full time forensic consultants. Our client base includes all of the major insurance companies, nationally and internationally, the HSE and the HSA and we cooperate with the Gardai.

Manus Coffey & Associates, has no political agenda, it will neither seek nor accept any payment for its opinions on the new children's hospital design. It is not acting for or at the direction of any group. It expresses no view on the location of the proposed paediatric hospital, it only wishes to ensure that the experience it has gained, from investigating incidents such as; food contamination, fires, explosions, and machinery/system failures, be considered in ensuring the health and safety of the staff and children in that facility when it is completed.

The author of this paper is a Chartered Engineer with forty five years industrial experience; ten of these years have been in the field of forensic engineering investigation.

The experience of Manus Coffey & Associates has ~~thought~~ taught us the following:

1. All systems fail occasionally.
2. All systems tend towards disorder.
3. Humans make mistakes.
4. Humans become complacent.

5. Simple systems/designs work best.
6. When multiple agencies are required to function together in an emergency errors and inefficiencies occur.
7. A significant number of normally rational human beings will panic during a serious incident.
8. The building designs that work best, in incidents, are those that rely on the minimum number of operational systems for their protection and have simple static systems in built in their design for their protection. Systems that cannot be altered or adjusted.
9. All facilities should be designed and sited to cater safely, efficiently and effectively for the purpose of their intended use and have simple defence systems inbuilt to reduce fire, flood, explosion and incident impact on them and their occupants.
10. Compliance with regulations is no guarantee of safety.

Requirements of a children's hospital:

My understanding of the requirements of a children's hospital is that it should include the following:

1. **Ensure that the children are given the care and protection, specific to their individual needs to restore them to health.**
2. **That the children are put at no risk from inefficient services, poor hygiene, poor design, fires, explosions, natural events or foreseeable risks or most importantly, human error in operation or design.**
3. **That in the event of a fire, explosion or incident such as a gas leak the rescue and response times are minimised. Remember evacuation needs to be effected within minutes of the event occurring.**
4. That the children can access the services with the minimum of risk.
5. That the facility design is flexible to allow it to grow in response to developing sciences.
6. That the facility can be altered to accommodate advances in medicine, medical practice, service requirements, building design and materials.

7. That in the future, the facility can be altered and expanded without impacting on the existing hospital services.
8. That the facility has built in redundancy to cater for disasters which can occur. (Lose one unit of the facility and the rest of the facility should be designed to accommodate the displaced occupants).
9. That the building can be built, expanded and altered with the minimum of expenditure.
10. That its future is not constrained by today's technological and budgetery limitations.

The first three points should never be compromised for any other objective.

Issues:

The design of the new hospital, as published in the media, shows a tall building on a small foot print. It is a fact that the smaller the foot print for a single fixed area facility, the greater the risks to the users. A single large foot print facility also holds significantly higher risks than a facility built with a number of small foot print units, each tailored to specific requirements.

The basis for this reasoning is as previously stated, human beings will make mistakes, designs will fail, systems will fail, cross infection will occur, hygiene requirements differ for different groups/units, fire, smoke and warm air all rise, so the lower the number of floors above an incident the less damage and the lower the number of persons involved in the incident.

The higher the facility the more specialised are the resources required to service it. (Fire fighting, water, ventilation, lifts, sewage etc, specialised services are more prone to failure.)

Sick children and immobile patients need assistance to evacuate; babies need individual attention to be evacuated. This requires a high input of specialised staff, available within minutes of any dangerous incident occurring. In a single, traditionally designed, high rise facility all the staff are required to address the danger of an incident throughout that complete facility, however in a multi foot print facility, staff can quickly deploy from the units at no risk, to assist at the unit requiring evacuation.

It is essential that the design of a children's hospital is such, that it reduces to a minimum, as many of the risks to the children in its care, as possible. Remember most high rise facilities cater for fit adult, mobile humans. In Ireland most high rise facilities are used as offices and are only occupied during day light hours and for 28% of the time that a hospital is occupied, a serious incident at night is significantly more difficult to deal with than a day light incident. Hospitals are occupied at night. Irish Fire services have little or no experience of handling incidents in high rise buildings.

This proposed children's hospital is intended as Ireland's sole centre of excellence, for many years to come and it is therefore critical that it is built not to a set of written safety standards but to a design that exceeds all standards and incorporates all known experience where possible.

Investigations conducted by MCA:

The following are summaries of some previous investigations carried out by the author. These investigations highlighted issues which should be considered when designing a safe building such as the new children's hospital: I would ask that you and all parties, with responsibility for the design and delivery of the proposed new hospital, question whether these issues have been adequately dealt with in the proposed design.

1. Hospital Fire:
   1.1. This fire was a small fire which occurred in a ceiling void. The fire spread from that area to the main dining hall and kitchens. The unit was a single storey satellite module.
   1.2 This fire was a small fire which quickly got out of control and generated large volumes of smoke. It was eventually contained by the fire brigade, who had quick, safe access to the fire.
   1.3 The fire destroyed / rendered inoperable over 14,500 square feet of the building.
   1.4 **Points to be noted from this incident:**
      1.4.1 The hospital remained functioning and no patients had to be evacuated. This was due to good basic concept design. It was not a multi storey unit.
      1.4.2 The fire brigade could access the fire from ground level, could bring all of their resources to bear on the fire and the fire could vent to atmosphere

quickly without passing through other facilities. This would not be possible in a high level building. Had this fire occurred in the proposed children's hospital it could have resulted in death and the closing down of the complete hospital.

1.4.3 Vital services for the hospital were nearly compromised.

1.4.4 The fire brigade had significantly clearer access to the scene than is proposed in the lay out of the new children's hospital.

2 Multiple manufacturing plant incidents: Three separate incidents, three explosions. These three explosions took place in organisations with the best written operating and safety systems in operation I have ever witnessed, with the most focused and trained of staff, and in a plants designed by experts and monitored by a number of state agencies.

2.1 First facility incident: For many years this plant carefully collected bi-product chemicals and returned them for processing to main land Europe. They stored them in small containers. The container supplier altered the specification of the container and the new container in combination with the stored product caused an explosion. This was a totally unforeseeable incident, but an incident which could have caused a fatality. **Point to be noted**; the container was stored in a low level satellite facility and damage was confined to that area. A post design change caused the incident, you can not design out failure but you can design in survivability.

2.2 Second facility incident: This explosion was due to a simple maintenance error. The level of preventative maintenance was excellent. **Point to be noted;** That one small error caused a significant explosion, again the explosion was in a single module area and damage was minimised by the layout and confined to that area.

2.3 Third facility incident: This explosion was due to a simple error, in implementing systems / procedures which were world class in every respect. The staff participated in compulsory continuous, six weekly training and retraining, more than any hospital staff will be subjected to. The explosion resulted in a loss of life and the destruction of the plant.

Point to be noted; the plant design incorporated many safety features but they all failed at the time of the incident. The facility was a high rise facility. If simple design features had been incorporated the impact of this incident would have been significantly reduced. A simple error can undo good practices and systems.

2.4 Prior to the incident the process was monitored by, reported on and tested by internal and external experts, all of whom failed to take a proper overview of the process and facility, therefore failed to foresee the potential for this incident.

2.5 The walls protecting the access stair wells were damaged and could have collapsed and did delay access to the site of the incident.

2.6 The plant was designed by internationally recognised engineering consultancy firms, however some very basic engineering errors were made, which contributed to the incident.

Points to be noted; take no comfort from titles such as "World Class" "International Consultants", "Best Practice", **Question Everything, particularly where safety is concerned and use simple systems which do not rely on human service and maintenance.**

3 Fire in multiple silos: This fire could have resulted in major property loss and injury due to a state agency putting pressure on the fire brigade and a lack of suitable equipment. The fire brigade equipment could not pump water to the height of the site of the fire and could not access the fire scene, because of its height. This fire was eventually extinguished by the company dropping sand onto it from high reach cranes. **Point to be noted;** Fire brigade resources and equipment have their limitations. The proposed hospital is significantly higher and more remote from the fire brigade access than the site of this incident was. Further the state agency did not understand the inherent danger of their request to the fire brigade, nor can they be expected to understand the dangers present at every fire scene.

4 Explosion in Municipal public offices: A small domestic hot water cylinder exploded due to a failure of a simple thermo stat on the immersion heater. The modern building suffered significant damage over three floor levels. The lifts were rendered

inoperable, fire doors were knocked down and rooms were destroyed. The incident happened before business hours, fortunately there were only a small number of persons in the building and only very minor injuries occurred. Multiple deaths could have occurred. **Points to be noted:** The building was built to modern standards but a simple failure caused the incident and showed the limitations of building regulations. It also showed that as time passes that alterations to existing facilities can compromise safety. Walls protecting the access routes were damaged. Access lifts failed and fire doors failed, up to three floors over the level of the incident, because of the presence of service shafts and lift shafts.

5 Alleged food infection in a number of food factories and production facilities: These investigations showed that the best intended aims and stated principles of hygiene and construction can fail in practice and possible sources of infection can be difficult to eradicate. Design detail is very important. **Points to be noted:** These investigations show that infections travel more readily vertically than horizontally, that infections are transmitted by personnel intermixing and by airborne transmission. Air continuously travels through service shafts, stairwells, lift shafts and service openings. That bacterium lodged in corners and joints are very difficult to eliminate.

6 Fire in a hardware store and in Longford Cathedral. **Point to be noted:** The fire brigade lifts could not lift more than three persons, moreover at maximum height and reach, their capacity is limited to two persons and that they are slow to deploy and move slowly and that they cannot be deployed in high winds. These buildings were approximately the height of a four story building; I understand that the proposed hospital will be seventy four metres high.

7 Damage to a national motor tunnel. **Point to be noted:** The layout of essential services was well addressed in this facility, with essential redundancy catered for but the measures to prevent damage to the tunnel failed. During the incident the services remained working in spite of suffering significant physical damage.

8 Industrial plant incident. International consultants designed the plant, local consultants altered specification for cost reasons. We predicted this incident and informed the firm of our concerns. The warning was ignored; the incident did occur and resulted in millions of euros loss and down time. The cost of correcting the fault

cost millions of euros, and subsequent investigation showed the same error repeated across many plants. **Point to be noted:** The designers of the facilities were experts in their particular field of factory design; they had no experience of investigating accidents and incidents and therefore did not have the necessary foresight.

9 Apartment fire / dormer house fire, where occupiers became totally disoriented. Two people lost their lives, in a room that opened directly out on to a street; the fire was a small fire not at the exit door. In a second incident a young man caught in a bedroom fire, ran past the front door of his apartment, which was located in the hall and not near the fire, he jumped out a window and broke his leg. **Point to be noted:** Fire causes panic and confusion in some rational humans.

10 Fire in processing plant.

10.1 The fire brigade turned off the electricity in spite of the pleas from the technical director, not to do so. This incorrect action caused an explosion which injured a number of staff and resulted in life long injuries to a number of persons.

10.2 The local authority Department of the Environment have tried to enforce dangerous designs on this company, these issues/design requests clearly come from inspectors who have no experience of the types of incidents/failures which occur in industry.

Points to be noted: That fire brigade training cannot be expected to cover all causes of incidents and that statutory regulations and planning requirements can compromise safety.

11 Fire in a processing plant.

11.1 This fire was caused by an incorrect understanding of a process by staff, in spite of the company having used this process for over a hundred years.

11.2 The fire preventative measures did not operate because a previously reported fault was not corrected due to the requirement to hold a safety meeting to carry out a risk assessment on the safe method of correcting that fault.

Points to be noted: Familiarity can cause complacency and compliance with system procedures can cause significant damage.

12 Fire in meat processing plant. Fire fighting facilities included access to a large water storage reservoir. On the night of the incident the necessary adaptors for connecting the fire pumps were not available. **Point to be noted:** Best intentions fail for the simplest of reasons.

13 Maintenance facility for large transport vehicles: This facility was designed and built by a number of nationally recognised consultants, builders and service contractors. **Points to be noted:**

13.1 The fire brigade refused direction from the technical manager to connect to the dry risers.

13.2 The fire alarm worked correctly, however a significant number of safety devices failed.

13.3 The design drawings contained multiple errors.

13.4 The installation did not comply with the drawings.

13.5 The facility was signed off as being complete, tested and compliant, by a reputable firm of consultants, which gave false comfort to the building owner/operator.

14 Large factory fire. A simple error by maintenance staff caused the fire. A simple initial adjustment of fire equipment spread the fire. **Point to be noted:** The first fire equipment used on site made a simple, short duration error, in dealing with a dust fire and spread the fire, an experienced fire officer corrected the fault but was too late and a significant portion of the facility was lost. This major facility was closed permanently as a result of this loss.

15 Observation: In one of Ireland's newly built hospital kitchens, I am informed by staff, that it was designed with a split level floor and was only altered after staff objections! **Point to be noted:** If this is correct, it raises the need for staff to be involved in the design concept and review, as must persons from other industries, where hygiene requirements are essential i.e. pharmaceutical, computers, food and dairy industries.

16 Fire in asphalt plant. A boiler housed in a reinforced building sprang a small leak of oil, the oil was under pressure and caused an explosion, the boiler house was

completely destroyed and the electrical switch room damaged. **Points to be noted:** If this event occurred in the proposed hospital, it would, in my opinion, close the hospital for at least a number of weeks. The extent of the damage was amplified by the constriction caused by the reinforced building. **This feature is repeated in the proposed hospital design.**

17 Investigations in food factories, pharmaceutical plants computer plants, abattoirs and piggeries: **Points to be noted:** Well run facilities of this type have very strict hygiene regimes in operation. When entering the facility you are required to give an undertaking that you are free of infections, you must wash your hands, entering and transferring from department to department, access is strictly controlled by the building design and the sequence of access to different departments is strictly ordered. Changes of clothing may also be required. Staff members are segregated to prevent / minimise cross contamination. The design of the proposed children's hospital shows that it would be very difficult to enforce such a regime. I have, in the course of my work, and privately visited hospitals and no such standards were observed, based on this observation I would ask that the design should be reviewed by persons from other industries where hygiene is important and the Department of Agriculture Food and Fisheries.

18 **Point to be noted:** In the majority of fires / explosions that we investigate, the **fire stopping materials/ methods** fail to perform their intended function, due to incorrect installation, poor maintenance or being displaced by the low grade deflagration which occurs in many fire situations. Note many explosions are followed by fire and explosions nearly always displace fire stopping materials.

Positive Design:

19 Hygiene: In a situation were hygiene is important such as, food factories, electronic equipment manufacturing plants or dairies, there are a number of features that are designed in, namely:

19.1 Prioritise the function of each department in terms of hygiene requirements and group units with equal requirements if possible.

19.2 Separate the staff and persons entering these departments to avoid cross contamination.

19.3 Consideration to the location of the entry points for material entering and exiting these departments.

19.4 Design these facilities so that they prevent the accumulation of any contaminant, dust or condensation. Have no hidden voids, eliminate all unnecessary corners.

19.5 Where required, fit departments with pressurised and filtered air supplies. Supply them with, clean, individual sources of air, with no possibility of cross contamination.

19.6 Design them so that they can be cleaned, sterilised and taken out of service if required without risk or interference to the surrounding rooms / departments.

19.7 Separate essential staff from the public.

19.8 Control staff entrance to comply with hygiene requirements.

19.9 Design the facility to prevent cross contamination.

19.10 Design the facility access so as to control access to approved persons only.

19.11 All surfaces such as floors, walls and ceilings should be hard, washable, smooth, all joints should be sealed and smooth. This does not mean that they cannot be decorated with child friendly colours and images.

20 Design of the building should include features to cater for the following:

20.1 The environment should be of a scale that is familiar and child friendly and suitable for each child's requirements.

20.2 **Patients with high risk from infection should not be in contact with infected patients from the moment they enter the hospital environment.**

20.3 The facility should have high, medium and low risk areas.

20.4 Parents should be able to go to and from the facility and be in a stress free environment. **They should not have to pass through**

corridors and lifts exposed to unnecessary number of other persons, who may be carrying infection or who may be in contact with infected patients.

20.5 Services which require servicing should be separated from high risk areas.

20.6 Any one unit should be capable of being expanded without impinging on the operation of the facility or causing any risk to any other part of the operation.

20.7 The facility should be capable of being expanded with out interruption to its daily operation and with out increasing the risk to the users of the facility.

20.8 Build in redundancy to ensure that the effects of a failure or an incident within the facility, such as any explosion, or plant failure can be rapidly nullified without interference to the operations of the overall facility.

20.9 Ensure that the effects of a major incident are limited and do not render a significant portion of the facility unusable.

20.10 In life threatening incidents, it is essential that evacuation can be under taken quickly and easily with out recourse to persons trained in evacuation skills. This cannot be achieved in a high rise, highly interconnected building housing sick children.

21 The facility should have all risks to it minimised. The placing of a helicopter landing facility should be in an area where the best conditions for safe flying prevail for the maximum possible window of time through out the year. Helicopters do crash and a crash on to a children's hospital is foreseeable and should be avoided. The higher the elevation, the greater the wind speed the greater the risk. If a helicopter site is required, **it should be placed remote from the entire hospital complex**. The Mountjoy Prison complex, will be vacated in the future, this should be considered as a site for the helicopter pad.

Particular issues:

22 In the early pictures of the new hospital a helicopter pad was shown on the roof. It is frightening that any designer of a children's hospital, a single centre of excellence, would ever have considered such a proposal.

23 The facility should be built to accommodate today's requirements with the ability to expand rapidly, simply and smoothly in the future. It is probable that the hospital will be still in use in one hundred years.

24 Remember that fire, smoke, airborne infections and fumes spread upwards in seconds, horizontally in minutes and downwards in tens of minutes. Why place the children's wards in a vertical stack, where all smoke, warm air and most gases can rise to and carry death and / or infection up to them? Further more remember that fire doors used to contain fires, do not contain warm air carrying airborne infections.

25 **Most fire victims die from smoke inhalation not flame. When exposed to smoke inhalation and faced with fire, this can cause some adult persons to behave irrationally. Smoke kills, inhalation can cause a person to collapse in seconds, not tens of minutes. The window of opportunity to escape is minutes, not tens of minutes. How would staff assist child patients under such conditions?**

26 Dublin fire brigade can effectively bring ground hoses to bear at a height of twenty metres. Not sixty metres. Dry risers with purpose installed pumps are required with emergency power supplies. These must work when required and must be effectively maintained. Experience teaches that complacency always creeps in. There are no hydraulic platforms or turn table ladders available to reach sixty metres. Subject to confirmation Dublin Fire Brigade have only two, thirty metre turn table ladders, one in the Tara street depot and one in the Dun Laoire depot. These would take too long to deploy. In a high rise building, **any fire above approximately six floors could only be fought by the fire brigade from the interior and below and that assumes the fire tenders can be brought along side the building.** The drawings and photographs of the model of the new children's hospital would indicate that the fire tenders cannot access the major portion of the perimeter of the building and the high central tower.

27 I have only read, studied non detailed drawings (Planning Application), viewed and listened to TV and news paper reports on the design of the new hospital.

27.1 Much of the public debate and publicity has centred on the architectural merits of the proposed building and on its conformity with the surrounding buildings and on it's influence on the Dublin sky line. **These issues should have no influence what so ever in the design of a facility, the designs sole overriding purpose should be to protect and care safely for sick children and to ensure that all risk to them is minimised.**

27.2 A sixty eight metre high building would take hours to evacuate, particularly as lifts may be inoperable or dedicated to fire fighting. Lifts cannot be used in the event of an incident involving gas for fear of explosion.

27.3 The shape and location of the proposed children's ward block makes it impossible to bring rescue equipment along side or access from the exterior.

27.4 The service shafts would all be vertical **and would act as chimneys which cause fire to develop and spread rapidly and spread infections faster and would reply on fire stopping to prevent fire spread**. They are all located in the very centre of the hospital building at the worst possible location in the layout.

27.5 The lifts all come from a common area on the reception floor and discharge onto common streets on each floor, bringing all persons into close contact, this is poor hygiene layout and greatly increases the risk of cross contamination.

27.6 It is generally recommended not to use lifts in fire situations. In some incidents I have examined, the lifts had become inoperable.

27.7 If any escape of a gas occurs it can permeate the entire structure above or below the point of escape depending on its density.

27.8 All stairwells and lift shafts act as chimneys and the lift cars act as pistons sucking and pushing the air/gases in the shaft causing them to be dispersed through out the surrounding corridors.

27.9 The building regulations generally cater for retaining fire for a limited period of time to allow the building to be evacuated. They are not designed to prevent the long term effects of fire spread. **Experience shows that the fire regulations and building regulations are deficient.**

27.10 The Planning Application documentation makes numerous references to the facility fitting into it's surroundings and being sympathetic to the surrounding architecture **but little to the very important issues of its purpose to return children to health in a safe environment.** In the planning submission there are no detailed services drawing provided. **In a safely designed hospital, the integrity of the M&E services is absolutely essential. The layout and routing of these services is critical to the robustness of the services in the event of an incident which might impinge upon them.**

27.11 **There is one single incoming electricity supply shown in the planning application.**

28 In the event of an emergency the surrounding street would become congested and access to the site would become constricted.

29 The form and shape of a hospital building must come after all of the requirements for the sick children, staff, hygiene, services, security, access etc **have been clearly defined, specified and frozen.**

30 I have witnessed modern hospitals with carpets on the floors, skirting boards, separate non washable surfaces and horizontal surfaces. The planning application shows little detail of the interior of the hospital, it is my understanding that many of the essential features of the interior of the building will not be subject to any independent statutory body and will be selected / recommended / approved by the HSE architectural staff and the board of the National Paediatric Hospital.

31 The proposed design is, from a visual perspective, very attractive, the design is heavily constrained by the foot print available to the architects. **The basis for the**

location of the hospital I do not express any view on, other than to highlight, the design constraints and risks that it introduces, these must be weighted against the reasons for the selection of that location and more importantly the particular foot print.

32 To build a hospital on a limited foot print and to confine all future expansion and alteration to that foot print is short sighted **and will influence the future care of children for probably more than one hundred years.**

The limited knowledge that I have of the new hospital design shows me that many of the above issues have been inadequately addressed.

Good design ensures that all of the above issues are addressed and the building when constructed ensures that the best possible ongoing services are provided, that risk is minimised and the possibility of human error is reduced.

A Design concept:

(If the hospital project is delayed for any extended period of time).

I would ask the persons charged with over all responsibility for the new hospital to give very serious consideration to the following:

Design the hospital based on a number of building modules interlinked by purpose specific, restricted corridors / tunnels, each building unit to be designed to cater for the requirements of specific groups of patients. Ensure that the access stair, public lifts, service lifts, service stair ways and service routes and service ducts (Vertical Access Service Unit) are all separate from the occupied area and outside the perimeter of each module and are, by simple layout, protected from an incident in a module and that the occupied module is protected from an incident in the access service unit. Ensure that fire, smoke or infection in any occupied module can, if required, be vented quickly but cannot spread upwards or downwards in a non controlled manner , or spread through the occupied area. Ensure that each module can be accessed readily by rescue and emergency service, i.e. clear open ground area around each occupied module. There are design concepts available which address all

of the above issues, and more importantly use static structural design to minimise risk. Ensure that where multiple floors are used in a module that each floor is separated from the floor above by a structure not compromised by stair opening, lift opening or service opening. Do not rely on fire stopping to contain fire spread and smoke.

Build the modules as required. This would also limit the upfront capital expenditure.

Space the modules so that they can be serviced / rebuilt or replaced as required.

A multi modular hospital, built as suggested, would in the event of a fire or explosion limit the danger to a specific module, escape from that module would be quick and the staff in the other non effected modules would be available immediately to assist.

A serious disease outbreak or infection could be isolated to a module and dealt with effectively.

Remember the proposed paediatric hospital is to be the centre of excellence for the next one hundred years.

The Mountjoy prison site and Garda station are in the ownership of the state. The prison has to be replaced, this would be an excellent site to build a children's hospital, a site which could incorporate the necessary safety features which cannot be catered for on the existing site. It would provide open space around the hospital. Further it opens onto the canal and this could incorporate a nice landscape feature. Alternatively use the Mountjoy site for the proposed future maternity hospital and allocate the site presently held for the maternity hospital to the children's hospital footprint, this would give the architects a significantly larger foot print to reconfigure their design and to incorporate significantly better health and safety features. It would half the height of the proposed building.

Minimum alterations to the existing design that should be incorporated:

1. Split each essential mechanical and electrical service into two locations, with 50% standby and 50% operating at each location. (Reason: Strategic redundancy in the event of a catastrophic services failure).

2. Build reinforced dividers between each service. (Reason: To stop a failure on one service impacting another service and potentially starting a chain of failures).
3. Ensure that each service unit has significant blow out venting. (Reason: To reduce the impact of a fire or explosion).
4. Locate all essential services above ground level. (Reason: To allow servicing, fire brigade access, escape and control of explosion forces and prevent incident spread. Do not locate essential services under the direct foot print of the hospital building. The proposed location of the hospital services is on level -4 in a heavily constricted zone. Fire brigade persons entering this area would be placed at considerable personnel risk, would have to wear breathing apparatus and would have no possibility of surviving a secondary explosion, this design issue should be referred to the HSA and the Dublin City Council who are the Fire Staff employers. Note the fire brigade's primary duty is to save life, not property, no fire person should be asked to risk their life to save plant, all be it essential plant required to keep the hospital working).
5. All oil and gas storage should be remote and only small quantities of oil should be fed forward under the facility as required. The design shows a large fuel storage area down on level -4. All major gas fuelled equipment should be located outside of the hospital building foot print. Remember natural gas is lighter than air and could rise up through the building. (Reason: To reduce the potential fire / explosion / poison load / risk within the building).
6. All lift and service shafts (Vertical Access Service Units) should be out side of the main structure, in particular those servicing the high level wards. (Reason: To prevent the spread of disease, smoke, fire and gases. It also allows public and staff access to be controlled and managed to prevent cross infection of patients and staff).
7. Lifts should be divided into a minimum of five satellites (Vertical Access Service Units), all top vented, connected to the individual floors by enclosed bridges. (Reason: In the event of an incident in or near one of these units 80 % of the access to all floors would still be available. The persons entering the ward units could be streamed to particular lifts, to reduce the risk of cross contamination.)

8. All floors structures on the ward levels should be continuous with no openings. (Reason: To prevent the spread of disease, fumes smoke, gas and fire upwards or downwards within the ward units. This design principle would, in effect, divide the presently designed monolithic structure into separate isolatable units and regain some of the benefits of building separate building units to house the hospital. It would eliminate the need for fire stopping. It would allow a fire to be fought from a number of points on any floor and the fire would have limited impact on the floors above or below.
9. All services should be run up through the five lift satellites and duplicated. (Reason: To ensure that essential services are maintained and restored as quickly as possible after an incident.)
10. All services should be paralleled and separate on both sides of the building. (Reason: Built in redundancy).
11. The incoming electricity supply to the hospital should be from two separately located ESB independent supplies via two well separated routes. (Reason: Built in redundancy).
12. The ward floor sections of the building should have external balconies run continuously around their perimeter, not for normal use, only for use in an emergency. (Reason: To stop any room becoming isolated during an incident and to provide a fire break to slow an external fire track up the building.)
13. The external shape of the ward section of the hospital is aesthetically very pleasing, however who will see it? It will look excellent from an elevated position; it will not be clearly visible from street level. What does it contribute to the children it houses? **Its design introduces numerous corners, every one of which is a dirt trap and will increase the risk of infection within the building.**
14. No lift shafts from the basement levels where plant rooms, goods inwards and car parks are located should come up into the hospital area proper, there should be separate lifts and these should discharge, under cover, out side of the hospital building footprint. Only the emergency ambulance lift should extend up into the hospital areas. (Reason: To prevent spread of fumes, smoke, disease, gas and to control entry to the hospital. A fire in a car will not be extinguished by a sprinkler

system. Cars can explode in a fire, there is no control on what is contained in the cars entering the underground car park, fires jump from car to car in a confined under ground car park).

15. No details of the individual ward designs are provided in the planning application. The limited detail available shows sharp corners and unnecessary corners. Corners are dirt traps and are difficult to clean. (Reason: Hygiene. The design should have modular constructed wards with smooth radii, capable of being easily renewed, repaired or replaced. Capable of deep sterilisation, I have seen no reference to such features in the planning application. A possible reason for the shape of the wards is to allow for bed access to narrow corridors to accommodate the shape of the ward block. In addition corners which jut out into corridors get damaged and damaged surfaces harbour germs. The corridors should be designed to be simple and quick to clean with mechanical cleaning equipment, the proposed design does not incorporate such a design.)
16. If the wards block, level 10 to level 15 foot print was increased in size and reconfigured the same number of wards could be accommodated on three levels as opposed to five levels, thus reducing the height of the hospital by over seven metres. The same reconfiguration could also probably remove an additional level and make space for an internal atrium sheltered from the weather which could be used by the occupants on a regular basis. The proposed roof top gardens, at ten stories high will only be usable on a vary limited number of days per year, due to the weather conditions and roof top winds.

Note: The costs incurred in reaching the present level of planning would not be written off if this reconfiguration of the hospital were to be ordered. The work to date has established a very detailed collection of data. The existing design spaces just have to be relocated.

Conclusion

In March 2011 I wrote to the Department of Health requesting a meeting to address the above issues. The first meaningful meeting only took place on the 4th October 2011. The reasons for requesting a meeting with the Board of the National Paediatric Hospital were as follows:

I am not an expert in medicine, hygiene, disease or running a hospital. The design concerns I have concerning the new hospital are based on actual observed historical incidents, some of which cost human life and all caused significant disruption. Contributing factors in these incidents are all present in the proposed hospital design. The persons ultimately responsible for delivering the new hospital are the Board of Directors and the persons that drew up the design brief for that hospital, whom I assume were the children's medical practitioners, nurses, doctors, hospital hygiene implementers and in house hospital safety officers. **To prevent a possible incident, all of these persons must be made aware of these incidents, as they do pose life threatening foreseeable risks to the future patients of the proposed hospital.**

I would further stress to those responsible parties that they should **take no comfort from the fact that the design complies with current building regulations, is designed by International Consultants, is defined as being to "Best Practice", "World Class" "Mission Critical" or is passed by An Bord Pleanala.** Base the design on all of these and on known experience of incidents. **Do not design a hospital with an inbuilt possibility of disaster, design it based on a configuration to minimise disaster.**

The reputation of the hospital will be earned over its life time by the excellence of its staff and how it performs in the event of an emergency incident during that life time.

After the persons charged with responsibility for approving and operating the hospital have heard my concerns I would be happy, free of charge, to sit with representative of these persons and outline my concerns to the hospital designers.