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Safety Survey of ATM Infrastructure

From Initiation to Implementation & Transfer to operations

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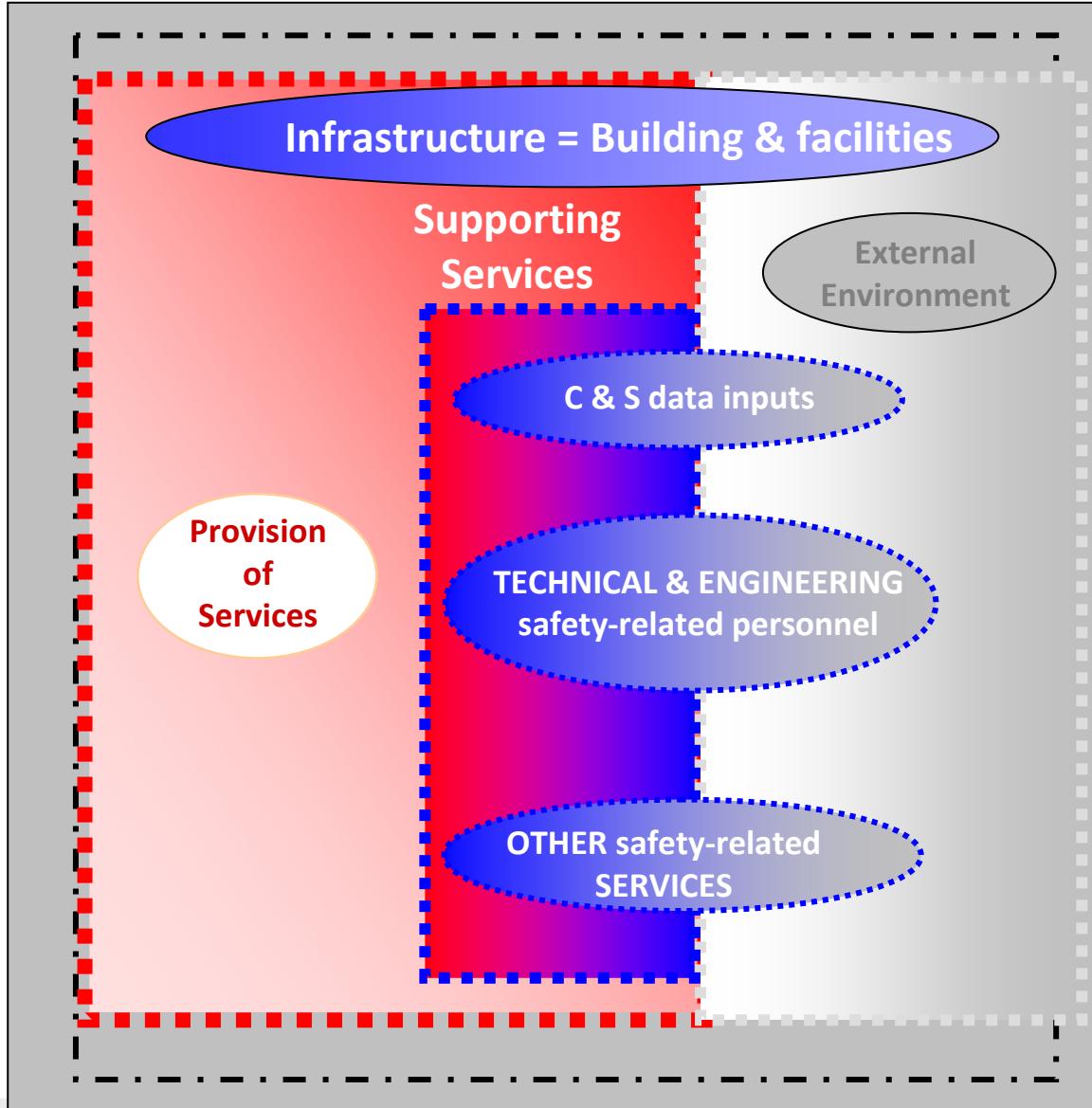


- ❑ Safety Survey Lessons Learned based on 3 different cases:
 - ✓ 1: full assessment of 1 ACC and survey implementation to close the work
 - ✓ 2: full safety survey implementation for 2 ACCs and C&S sites
 - ✓ 3: combination of Safety Assessment and Safety Surveys for 1 ACC

- ❑ These 3 cases allowed to define best practices to carry out Safety Surveys of Infrastructure



Environment of operations



- Location**
- Structure**
- Power Supply,**
- Fire Strategy,**
- Heating Venting Air Conditioning**
- Water Supply,**
- S/System Facilities Management**
- C & S data cabling**
- Telecom network**
- Sub/Systems network/cabling**
- Ergonomic**
- Security**

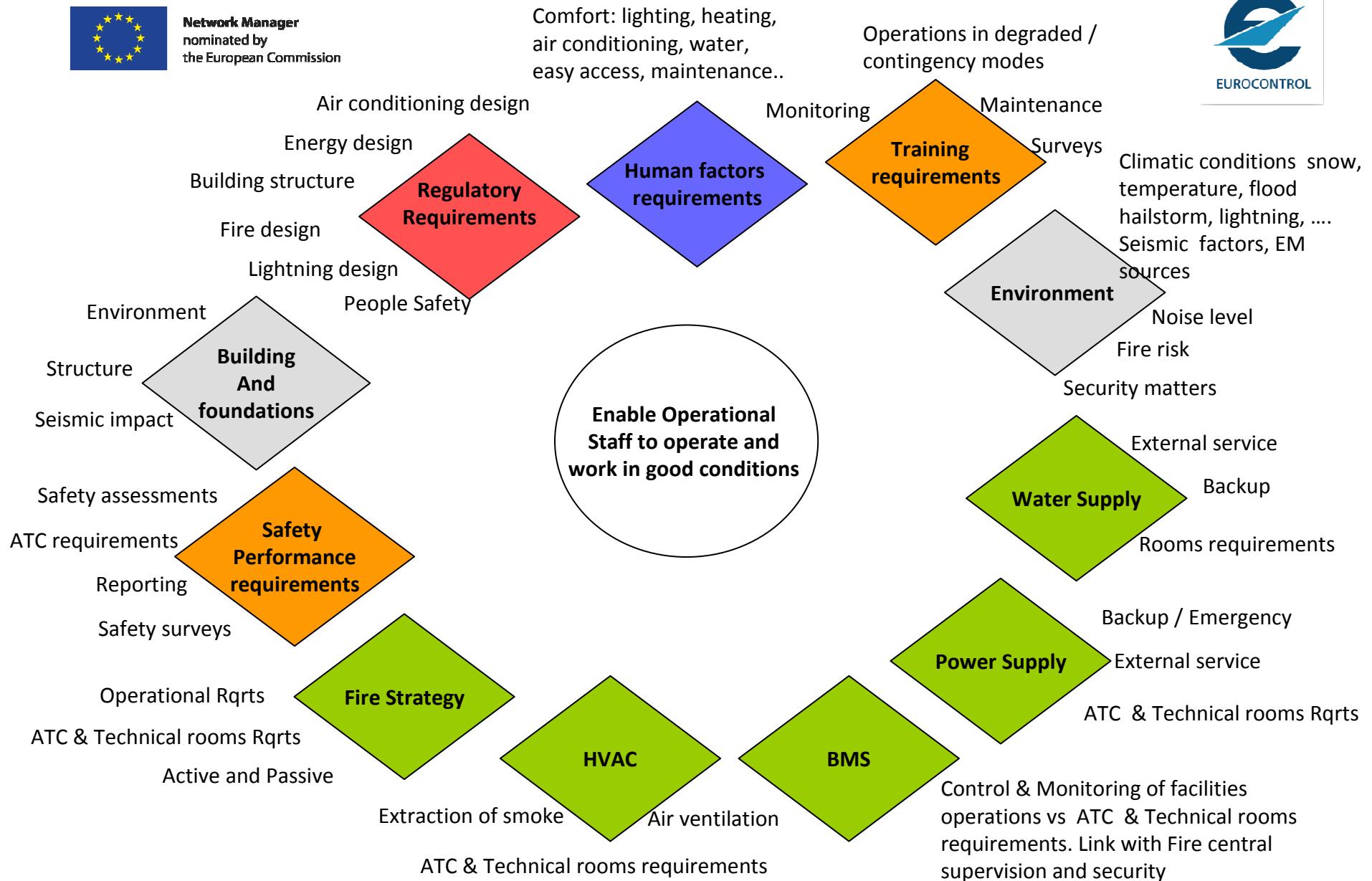


Description of System and its Environment

1. **What we have to comply with e.g. '*Local regulations or European*'**
2. **What we may have some control on e.g. *facilities***
3. **What we must adapt to e.g. *geographical environment***
4. **What we should endeavour to care for e.g. *human factors***
5. **What is necessary to maintain the durability of the "System" e.g. *qualifying maintenance staff, maintenance strategy,..***



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Also need to know about CNS data network & Telecom network, Software of BMS modules, Security (network and site)



Getting started – Fixing the mission of the Infrastructure

Functional needs

- ✓ to enable Controller to provide services and operate in good working conditions
- ✓ to host people, vital areas (ATC room & Technical room, backup room - simulation/training, Telecom room, Power Supply & Fire Safety main board,)

System Requirements

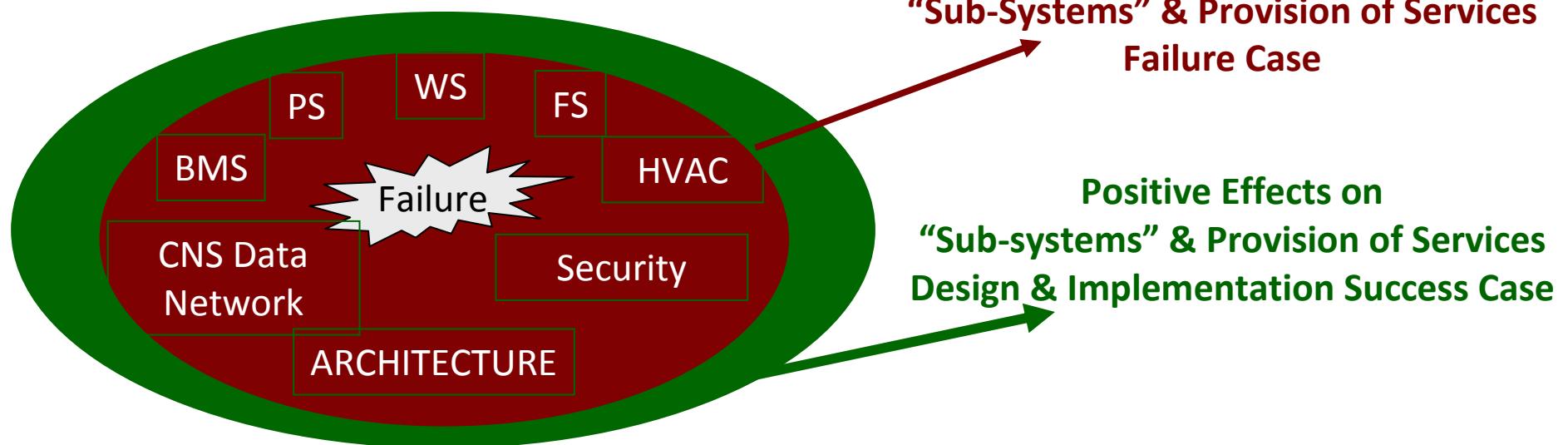
- ✓ definition of time duration for the transfer of operations to the backup room or neighbour and evacuate the building
- ✓ definition of the operational environment (operations & technical, location)
- ✓ identification of tolerable risks vs degraded mode of operations taking into account airspace characteristics (traffic flow, sectorization,...)
- ✓ description of S/Systems operations (Power Supply, HVAC, Fire Strategy, System Facilities Management, Water Supply, Security,...)



Building Parameters	Standard value (if applicable design & Implementation)
• Time to evacuate the building(s)*	• 30 minutes (for instance)
• Acoustic levels for OPS room(s)	• NR 35 (Curve level function of the frequency)
• Vibration levels for OPS & TECH room(s)	<ul style="list-style-type: none">• Vertical<ul style="list-style-type: none">• 0,10 mm/s RMS (8-80 Hz)• 0,1 m/s² RMS (1 - 8 Hz)• Horizontal<ul style="list-style-type: none">• 0,1 mm/s RMS (>2 Hz)
• Lighting levels for OPS room(s)	<ul style="list-style-type: none">• consoles: 300 lux• ceiling: 150 lux• walls: 100 lux
• Temperature & Humidity levels for OPS and TECH room(s)	<ul style="list-style-type: none">• $23 \pm 2^\circ\text{C}$• 40 - 60 %
• Limits to air velocity in OPS and TECH room(s)	<ul style="list-style-type: none">• measured on the high of 1.8m from the floor<ul style="list-style-type: none">• 20°C 0,13 m/s• 23°C 0,15 m/s• 25°C 0,18 m/s
• Power Supply (UPS and Fuel tank)	<ul style="list-style-type: none">• To satisfy contingency requirements as a minimum



What are we trying to achieve by surveying the Infrastructure?



Consequently

- ✓ Assess failure effects of the infrastructure at Sub-systems level
- ✓ Assess failure effects of the infrastructure at Services level
- ✓ Identify best practices that will support tests strategy, maintenance strategy,



✓ Scope of Safety Surveys

- Compliance to regulatory standards (National or European)
- Consideration of operational & technical RQRTS, and environmental location
 - EMC, Acoustic, Vibration, Lighting, Lightening, Temperature level, Humidity level, limit of air velocity for Ops/Tech
 - Time for evacuation (detection, analysis, decision making, closure/transfer of the airspace, evacuation of ATCO/ATSEP)
- Documentation availability
- Risk evaluation
 - Single point of failure, redundancy principles for sub-systems (PS, HVAC, Fire safety, Water Supply & drainage, BMS, Security, Cabling network, Telecom cabling, CNS data cabling,)
 - Risks evaluation Implies also analysis of sub-systems Interfaces, and quality of materials and equipment/components used
 - Civil Works best practices (design & implementation)



S/System Mission – Example for Power Supply

❑ Components that need to be carefully examined

- ✓ Single point of failure (MDB/Centralized DB, DB for vital areas,...)
- ✓ No break and Zero break equipment (impact on Maintenance as well)
- ✓ Selectivity of network components & Harmonics
- ✓ Lightning protection network
- ✓ Cabling protection against rain/sun, fire, rodents (applicable to all S/Syst) and violation action risk
- ✓ Switch to Emergency Diesel Generator automatic or not
- ✓ Emergency Diesel Generator redundancy and autonomy
- ✓ UPS redundancy and autonomy to be equal to time to transfer operations & evacuate
- ✓ Batteries capacity Loads
- ✓ Interface with other sub-systems like water pipe, BMS, Fire...
- ✓



- *Sizing of the electrical distribution installation (PS1, PS2, PS5) : The sizing of cables , DB, bus bar and circuit breakers is not adapted to the electrical loads. No information about selectivity.*
 - ✓ *Assess the electrical distribution with a specific software in order to improve the present situation and to prove that total selectivity is achieved.*
- *Single points of Failure (SPOF's) exist which are critical for the availability of the electrical Power Supply.*
 - ✓ *to modify electrical network to remove Single Points of Failure*
- The BMS power supply is not connected to the UPS.
 - ✓ *To connect the BMS to the UPS*
- A new installation of protection against lightning in conformity with EN 62305 has been installed.
 - ✓ *To install SPD (Surge Protective Devices) in the Distribution Boards.*
 - ✓ *Earth resistance will be measured.*
- *Discrimination of operational and non operational critical sockets (Ops room, Technical room, ...)*
 - ✓ *To check all critical areas that sockets supplied by UPS are clearly identified*



- *Level of harmonics: No measurement of harmonics level has been made at the different levels of the distribution. (Risk=loss of PS for ATC equipment..*
 - ✓ To carry out the measurement of Harmonics. If the level of harmonics is to high, necessary action should be taken to avoid damage of equipment. *Measurement is to be made on complete configuration*
- *In case of a total power supply failure a UPS system is used for backup. Actually this UPS in the Worst Case (maximum load) ensures 15mn operations. The minimum time covered by the UPS should be the time necessary for fire detection, decision making and evacuation.*
 - ✓ To measure the time of operation of the UPS on battery with all critical equipment connected and to adapt the UPS and battery accordingly
- *In the cable trays Power cables and Signal cables are not separated.*
 - ✓ To take the necessary actions to be sure that EMC requirements are fulfilled
- *In the present situation the Distribution Boards supplying power to the critical areas are not protected against fire.*
 - ✓ To propose and implement a solution to protect these Distribution Boards against fire
- *In the present situation 20 subcontractors are involved in the maintenance activities.*
 - ✓ One person should have the responsibility to be the focal point for these different contracts



S/System Mission – Example of Fire Strategy for Vital Areas

Components that need to be carefully examined

- ✓ Structure, coating and fire wall
- ✓ Evacuation of smoke and interface with Ventilation
- ✓ Presence of gas circulation
- ✓ Presence of electricity wire or power cable
- ✓ Devices to detect fire smoke
- ✓ Presence and use of lift
- ✓ Availability of fire extinguishers
- ✓ Emergency lighting and escape way
- ✓ Access of rescuers/Fire Brigade
- ✓



✓ **Finding: Actual configuration of the passive & active fire safety provisions not known and not documented**

★ Consequence: Repair, Maintenance and Upgrade Operations difficult

➤ Recommendation: Produce as built drawings with

- *Fire compartments with boundaries and numbering*
- *Surface of the fire compartments*
- *Fire rating of the fire compartments boundaries*
- *Emergency escape exits with panic bars*
- *Length of escape ways*
- *Emergency lighting*
- *Fire doors positions with rating*
- *Position and wiring of detectors, alarms, sprinklers, gas bottles, piping,..*



- ✓ **Finding: BMS is not used for Fire safety purposes.**
- ★ Consequence: Not efficient monitoring of fire alarms and detectors. Risk of no identification of false alarms. Personnel and equipment safety
- Recommendation:
 - *The Fire Alarm Control Panel has to be linked with the BMS.*
 - *The BMS must be surveyed by competent personnel on 24 hours basis*
 - *Three Fire Teams must be put together and trained to face any situation until the arrival of the fire brigade*
- ✓ **Finding: OPS room and Backup room are not provided with two independent detection systems**
- ★ Consequence: No redundancy, loose of wiring and equipment important to operations
- Recommendation:
 - *We recommend to install in the space under the false floor the so called VESDAs (Very Early Smoke Detectors) linked to an alarm*
 - *Examine the possibility to install also a local fire fighting system in this space*



- ✓ **Finding:** *Rooms hosting critical electromechanical equipment not adequately protected with respect to their safety significance*
- ★ **Consequence:** *Fire and smoke propagation in no fire affected areas. Loss of critical equipment use for the provision of services*
- **Recommendation:**
 - *Automatic Fire Detection Extinction System by means of Argon Gas to be installed*
 - *Ventilation must be provided by means of movable louvers from outdoors*
 - *Louvers or other openings doors to be sealed with fire resistant material (60 min resistance)*
 - *Not adequate doors to be removed and replaced*
- ✓ **Finding:** *It is not verified that the fire dampers in the air ducts will operate in case of a fire/smoke detection*
- ★ **Consequence:** *Contamination with smoke of areas not affected by fire, feeding of fire with fresh air*
- **Recommendation:**
 - *Identify the location of fire dampers and verify that all fire compartments can be isolated (both air supply and extraction)*
 - *Simulate a performance test (closing of dampers in case of smoke/fire detection)*



Rationale for Tests Strategy

❑ Tests on vital / critical areas

- ✓ Classification
 - Indispensable, impact of OPS
 - Highly desirable, no direct impact on OPS
 - Desirable, no impact on OPS

- ✓ Satisfaction to Manufacturer Requirements vs ATC equipment
- ✓ Operational Tests Nominal Mode (success case)
- ✓ Operational Tests Degraded Modes (failure case)
- ✓ Performance Tests for sub-system like HVAC



Ideally Surveys of Infrastructure is a Combination of SA & SS

Safety Assessment / Survey of Drawings and Documentation Availability

- ✓ On site Risk analysis based on sub-systems Drawings and Documentation
- ➡ List of Recommendations (classification & reference number)

RM : Major (Unacceptable)

Rm : Minor (Tolerable)

Rμ : Maintenance activities

Ra : Improvement of function roles, performance, ...

Survey types

- ✓ *Initiate (focussing on sub-systems recommendations from design)*
- ✓ *Factual implementation (focussing on sub-systems implementation)*
- ✓ *Transfer into operations (focussing on tests strategy and follow-up surveys findings)*
- ✓ *Monitoring (focussing on sub-systems inspection and maintenance strategy)*



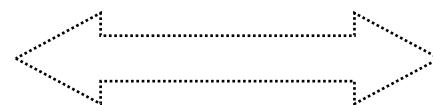
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Requires a Pool of Experts : Civil Work and Safety

Project Team

Head of Project
Technical Manager
Safety Experts
Civil Works Experts

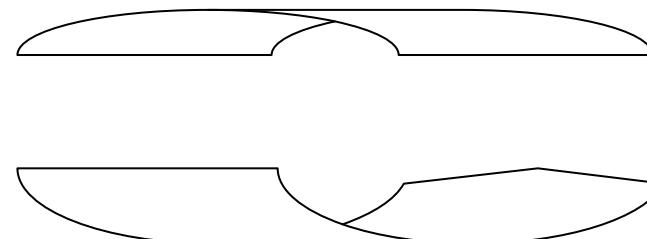


Focal Point
Technical Managers / sub system
Technical Experts / sub system
Consultants

Consultancy

Internal Meeting
Safety & CW Task-Force
Risk Project Management

Project Management



ANS

On site meetings
On site safety surveys

✓ *On site Survey of the overall system (one week – 6 experts)*



Risks Identifications

- ✓ Incomplete technical specification,
 - no description of sub-system and impact on maintenance strategy
- ✓ No Drawings Configuration from design to implementation and as built,
 - impact on follow-up of a change in the architecture/network of the sub-system
- ✓ Availability of ANSP's CW contractors (right persons)
- ✓ Delay in the delivery and integration of sub-system
 - integration leading to modification of existing sub-system & interfaces



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Safety Survey Lessons Learned report on development

This report will provide detailed information and best practices

First draft version planned February 2013

Released version planned March 2013



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