

AMS-IX Data Centre Standard

A Standard defining the minimum acceptable, and also the desirable levels, of technical implementation, resilience of operation and business continuity management for data centres providing services to the Amsterdam Internet Exchange



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1 Introduction

The successful and reliable provision of data centre services depends upon the following;

- A well designed and constructed plant that takes into account appropriate Standards and best practice to achieve efficient and reliable operation
- Management techniques that put in to place operating procedures and protocols that ensure the continuing efficient and reliable operation of the data centre
- Disaster recovery plans that have an established and rehearsed procedure for dealing with any incident that impairs the operation of the data centre and puts in to place a recovery programme

Technical Standards

Technical Standards give the best practice methods for designing and implementing the data centre from a physical, electrical and mechanical viewpoint. Some requirements covering health and safety and energy management are covered by European Directives and national standards. Many technical standards exist that cover the myriad of engineering disciplines encountered in a data centre but the main design standards referred to are

- ANSI/TIA-942-B:2017 *Telecommunications Infrastructure Standards for Data Centers*
- ASHRAE TC 9.9 2011-2015 *Thermal Guidelines for Data Processing Environments – Expanded Data Center Classes and Usage Guidance*
- EN 50600:2012-2019 *Data centre facilities and infrastructures*

Standards applicable to data centres in the Netherlands are

Arbo Informatieblad 32 dat zich richt op legionellapreventie in industriële koelwatersystemen en proceswatersystemen

Blusinstallaties Veiligheidsaspecten:2017 VEBON

Directive 2003/10/EC - Minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (noise)

IEC 60825-1 ed. 3.0 Safety of laser products - Part 1: Equipment classification and requirements

IEC 61000-4-2 ed2.0 Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test

IEC 61537 ed. 2.0 Cable management - Cable tray systems and cable ladder systems

ISO 8528-10 Reciprocating internal combustion engine driven alternating current generating sets

ISO 9001:2015 Quality management systems. Requirements

ISO 14644-1 Cleanrooms and associated controlled environments — Part 1: Classification of air cleanliness

EN ISO 16890-1:2016 Air filters for general ventilation. Technical specifications, requirements and classification system based upon particulate matter efficiency (ePM)

ISSO-publicatie 55.3 Legionellapreventie in klimaatinstallaties

NEN-EN 779:2012 Particulate air filters for general ventilation - Determination of the filtration performance (now replaced by EN ISO 16890)

NEN-EN-ISO 7010 Grafische symbolen - Veiligheidskleuren en -tekens - Geregistreerde veiligheidstekens

NEN 3011 Veiligheidskleuren en -tekens in de werkomgeving en in de openbare ruimte

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NEN 6088 Brandveiligheid van gebouwen - Vluchtwegaanduiding - Eigenschappen en bepalingsmethoden'

NEN 1414 Symbolen voor veiligheidsvoorzieningen op ontruimings- en aanvalsplattegronden

NEN 1413 Symbolen voor veiligheidsvoorzieningen op bouwkundige tekeningen en in schemas

NEN ISO 14122-1/2/3 Safety of machinery. Permanent means of access to machinery levels

NEN-EN 54-1:2011 - Fire detection and fire alarm systems - Part 1: Introduction

NEN-EN 54-20:2006 Fire detection and fire alarm systems - Part 20: Aspirating smoke detectors

NEN 1010:2007+C1:2008 Safety requirements for low-voltage installations

NEN 1366-3:2009 Fire resistance tests for service installations. Penetration seals

NEN ISO 1461:2009 Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods

NEN 1751:2014 Ventilation for buildings. Air terminal devices. Aerodynamic testing of damper and valves

NEN-EN 1838:2013 Lighting applications - Emergency lighting

NEN 2535:2017 Fire safety of buildings - Fire detection installations - System and quality requirements and guidelines for detector siting

NEN 2575-1:2012 Fire safety of buildings - Evacuation alarm installations - System and quality requirements and guidelines for locating of alarm devices - Part 1: General

NEN 3140+A1:2015 Operation of electrical installations - Low voltage

NEN 8012:2015 Selection of the cable type with the objective to limit the damage due to fire of electrical and optical fibre wiring systems or flame spread along electrical and optical fibre wiring systems (Keuze van het leidingtype met als doel het beperken van schade als gevolg van brand van en via elektrische leidingen met inbegrip van glasvezelleidingen)

NEN-EN 12464-1:2011 Light and lighting - Lighting of work places - Part 1: Indoor work places

NEN-EN 12825:2001 Raised access floors

NEN-EN 13501-1:2007+A1:2009 Fire classification of construction products and building elements

NEN-EN 13501-6:2014 Fire classification of construction products and building elements. Classification using data from reaction to fire tests on electric cables

NEN-EN 15004-1:2008 Fixed firefighting systems - Gas extinguishing systems - Part 1: Design, installation and maintenance

NEN 50310:2016 Telecommunications bonding networks for buildings and other structures

NEN 50172:2004 Emergency escape lighting systems

NEN-EN 50173-1:2011 Information technology - Generic cabling systems - Part 1: General requirements

NEN 50173-5:2010 Information technology, Generic cabling systems, Data Centre cabling

NEN 50174-1:2009+A1:2011 Information technology. Cabling installation. Installation specification and quality assurance

NEN 50174-2:2009+A1:2011 Information technology. Cabling installation. Installation planning and practices inside buildings

NEN 50174-3:2013 Information technology - Cabling installation -- Part 3: Installation planning and practices outside buildings

NEN-EN 50267-2-3:1999. Common test methods for cables under fire conditions. Tests on gases evolved during combustion of materials from cables.

NEN IEC 62485-1:2018 Safety requirements for secondary batteries and battery installations. General safety information

NEN 50346:2002+A2:2009 Information technology. Cabling installation. Testing of installed cabling

EN 50399:2011+A1:2016 , Common test methods for cables under fire conditions – Heat release and smoke, production measurement on cables during flame spread test – Test apparatus, procedures, results

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NEN-EN 50600-1:2019 Information technology - Data centre facilities and infrastructures - Part 1: General concepts

NEN-EN 50600-2-1:2014 Information technology - Data centre facilities and infrastructures - Part 2-1: Building construction

NEN-EN 50600-2-2:2019 Information technology - Data centre facilities and infrastructures - Part 2-2: Power distribution

NEN-EN 50600-2-3:2019. Information technology. Data centre facilities and infrastructures. Environmental control

NEN 50600-2-4:2015. Information technology. Data centre facilities and infrastructures. Telecommunications cabling infrastructure

NEN-EN 50600-2-5:2016 Information technology - Data centre facilities and infrastructures - Part 2-5: Security systems

NEN-EN 50600-3-1:2016 Information technology - Data centre facilities and infrastructures - Part 3-1: Management and operational information

NEN-EN 50600-4-1:2017 Information technology - Data centre facilities and infrastructures - Part 4-1: Overview of and general requirements for key performance indicators

NEN-EN 50600-4-2:2017 Information technology - Data centre facilities and infrastructures - Part 4-2: Power Usage Effectiveness

NEN-EN 50600-4-3:2017 Information technology - Data centre facilities and infrastructures - Part 4-3: Renewable Energy Factor

NEN-EN 60034-3:2008 Rotating electrical machines. Specific requirements for synchronous generators driven by steam turbines or combustion gas turbines

NEN 61034-2, Measurement of smoke density of cables burning under defined conditions – Part 2: Test procedure and requirements

NEN EN IEC 60332-1-2:2004+AMD1:2015 CSV Consolidated version Tests on electric and optical fibre cables under fire conditions - Part 1-2: Test for vertical flame propagation for a single insulated wire or cable - Procedure for 1 kW pre-mixed flame

NEN 60754-2:2013 Test on gases evolved during combustion of materials from cables - Part 2: Determination of acidity (by pH measurement) and conductivity

NEN-EN 61034-2:2005+A1:2013. Measurement of smoke density of cables burning under defined conditions. Test procedure and requirements

NEN-EN-IEC 61439-1:2011 Low-voltage switchgear and control gear assemblies
PGS30 (Vloeibare brandstoffen: bovengrondse tankinstallaties en afleverinstallaties)

Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases

REGULATION (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC

NPR-CLC/TR 50600-99-1:2017 Information technology - Data centre facilities and infrastructures - Part 99-1: Recommended practices for energy management

ISO 1716:2010 Reaction to fire tests for products -- Determination of the gross heat of combustion (calorific value)

TIA942-B:2017 Telecommunications Infrastructure Standard for Data centres

One central plank of the design philosophy is the adoption of the N, N+1 and 2N methodology. Briefly, N means enough items to do the job at hand, N+1 means that each system has one redundant component and 2N means that systems are completely replicated. Other variants may be 2(N+1) for example, meaning two independent systems where each system also has redundant components. Ultimately it is a risk versus cost strategy as more levels of redundancy and resilience

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will invariably cost more. Organisations are invited to consider the costs of downtime to their own business before they decide upon the strategy most appropriate to their business.

The hierarchy and order of precedence of standards for the Netherlands is

- Laws, Regulations and Statutory Instruments of The Netherlands
- Directives of the European Union
- National (NEN) standards accepted in The Netherlands
- CENELEC standards
- ISO/IEC standards
- Other relevant national standards, e.g. ANSI, TIA, BSI, VDE
- Industry best practice

Business Continuity standards

Building a data centre to the latest standards and incorporating the requisite availability/redundancy techniques is only the first step to successful long term operation. The next stage is managing the data centre and being prepared for technical failures or any other event that impinges upon the data centre operation. This area generally comes under the heading of Business Continuity Management, BCM. BCM standards can be generally aimed at all businesses and enterprises whereas some are more focused on Information and Communications Technology, ICT.

The following Standards have been identified which cover this area.

ISO/IEC 20000-1:2011 Information technology. Service management. Specification

ISO/IEC 27001:2017 Information technology. Security techniques. Information security management systems. Requirements

ISO/IEC 27002:2017, Information technology. Security techniques. Code of practice for information security management

ISO 22301:2019, Business continuity management

ISO/IEC 27031:2011 Information technology. Security techniques. Guidelines for information and communication technology readiness for business continuity

NFPA 1600:2019 Standard on Disaster/Emergency Management and Business Continuity Programs

PCI DSS (PCI Data Security Standard): 2018

There are also generic quality management standards that all companies would aspire to, including datacentres. ISO 9000 in particular has a requirement for the management and maintenance of an effective document control system.

EN ISO 9001:2015 Quality management systems. Requirements

EN ISO 14001:2015 Environmental management systems. Requirements with guidance for use

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2 Minimal expectations of AMS-IX

2.1 Availability:

Maximum number of incidents;

- 1 outage in 5 years, maximum downtime of two hours
- Mean Time Between failures of not less than five years

2.2 Environmental conditions for network equipment

The temperature and humidity of the computer room must remain within the limits set by this standard.

2.3 Fire suppression:

The facility must be protected by a high sensitivity automatic smoke detection system coupled with an automatic fire suppression system.

2.4 Maintenance regime:

- Maintenance on critical items must take place at agreed times
- AMS-IX must be notified of Maintenance on critical items at least one week in advance. AMS-IX preference is for maintenance to be done during 07h00-12h00 (GMT +1h). Incident Management, i.e., to bring a component back into production after a failure, should be done between 00h00 and 07h00 Maintenance. If the data centres maintenance windows deviate from these then AMS-IX must be given formal notification of the normal maintenance windows. There will be no routine maintenance work on critical items outside of these time windows

2.5 Incident management

- Incidents must be managed in a way that allows adequate response and analysis
- Outage announced within 5 minutes to AMS-IX Network Operations Centre, NOC
- Outage announcements to be made through systems that are independent from the power equipment production environment

2.6 Personnel

- Only qualified personnel used for maintenance
- A communications escalation procedures & contact information
- Regularly inform AMS-IX on update escalation contact information
- Efficient site access for authorised AMS-IX staff

The requirements will be met through three areas;

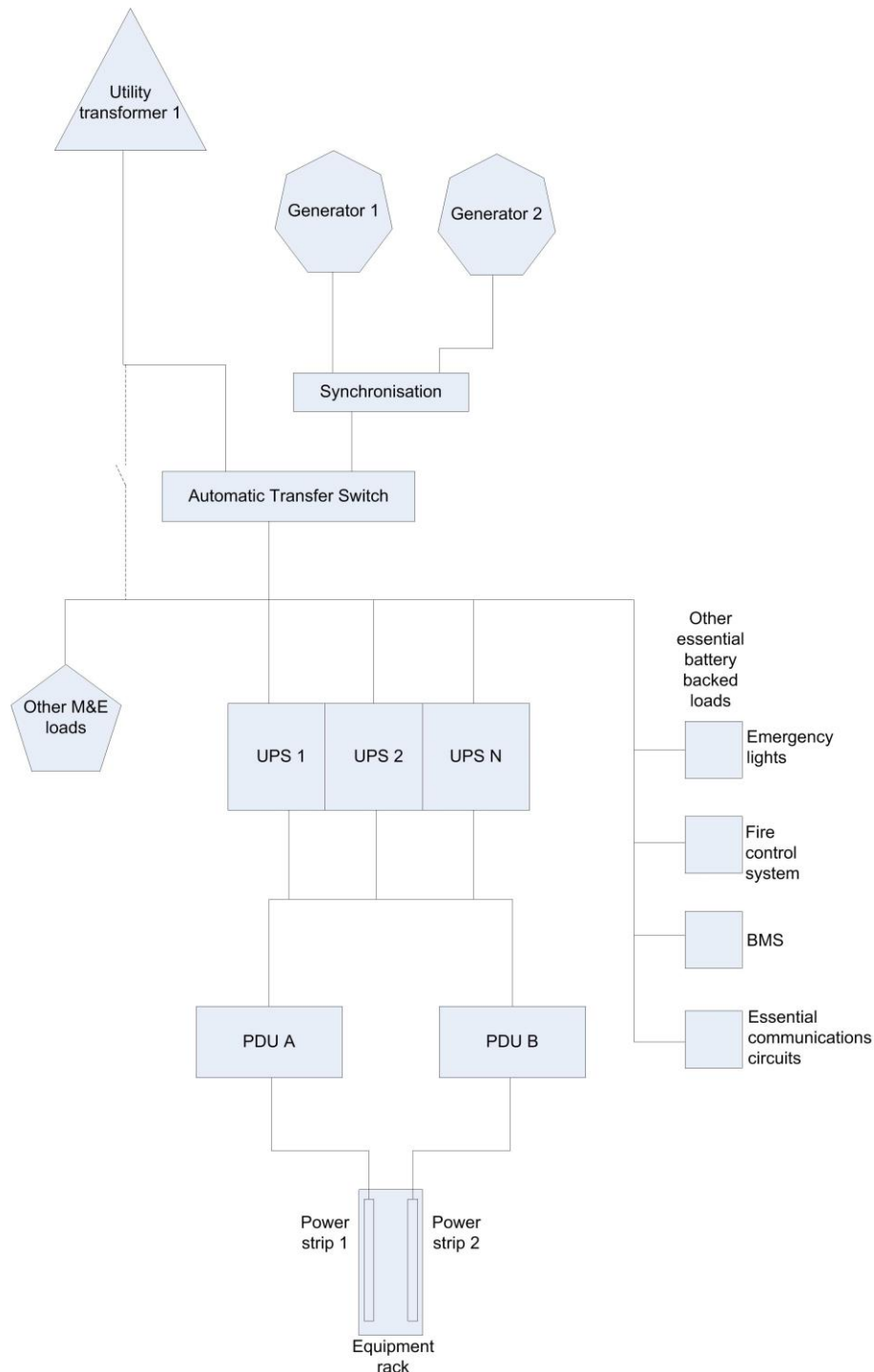
- The technical design and installation of the data centre
- The management and maintenance procedures to operate the data centre
- A business continuity and disaster management programme

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- The Minimum Requirements of AMS-IX shall be proven by an audit of the data centre facility by an external qualified auditor acceptable to both AMS-IX and the operator of the data centre

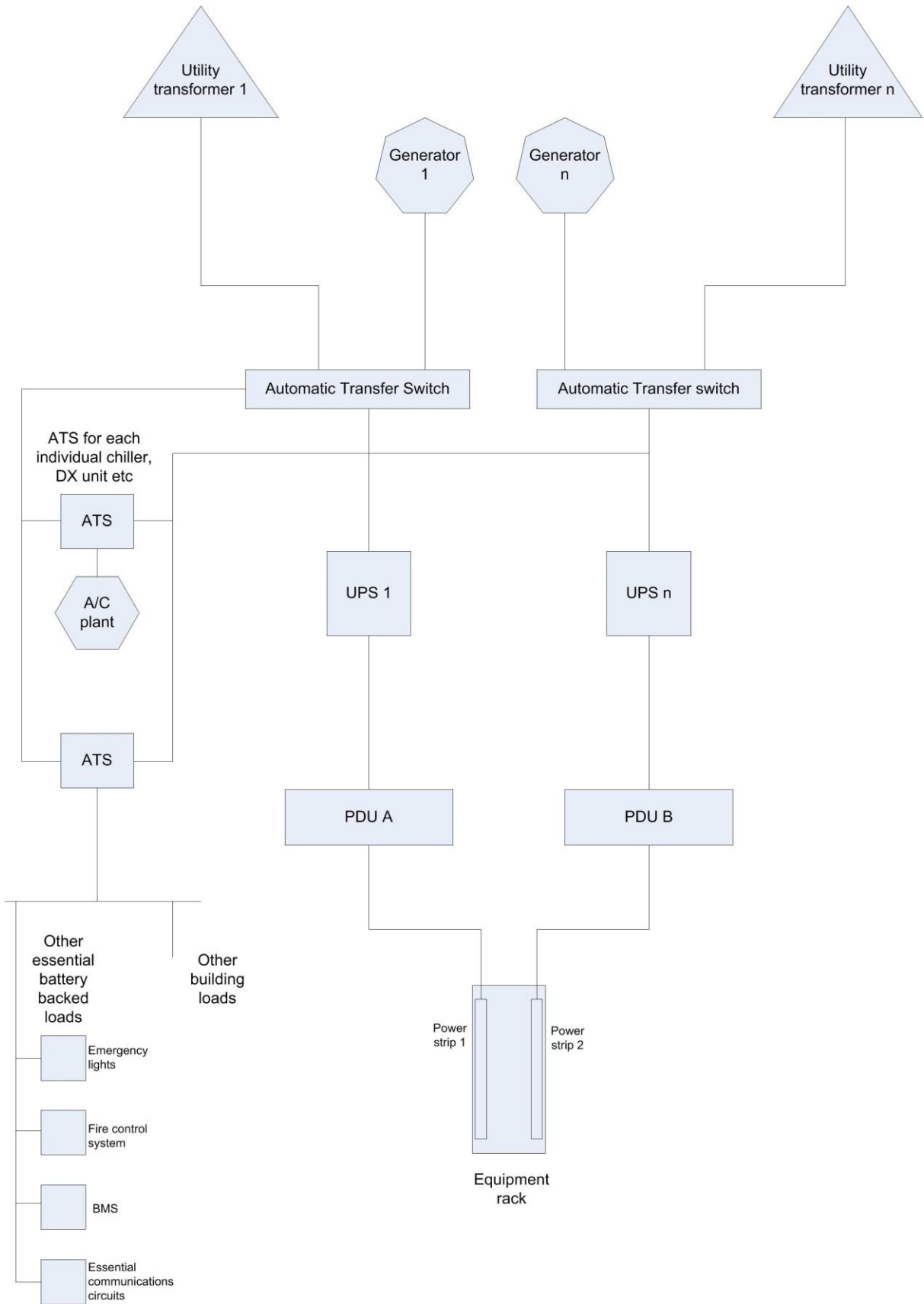
Minimum and recommended power provision

The minimum required power provision is an N+1 design. An example is shown here. The principal elements must be concurrently maintainable hence the bypass switch allowing maintenance of the Automatic Transfer Switch.



Minimum power distribution for data centres

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Recommended power distribution for data centres

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3 Audit protocol

The AMS-IX approved auditor will

- Establish contact with the applicant’s technical representative
- Agree a mutually convenient date for the audit
- Identify exactly who the AMS-IX auditor will be and bring proof of identity on the day
- Obey all the client’s rules on security, site health and safety and confidentiality
- Keep the client’s data confidential except where information is approved for release or is in the public domain
- Only release the audit results to the applicant organisation and AMS-IX
- Not touch any client’s equipment without express permission

The applicant organisation will

- Identify a technical representative and agree a mutually convenient date for the audit
- Allow access to all parts of the site and allow measurements and photography to be taken as required
- Provide suitable technical staff on the day of the audit capable of explaining all technical aspects of the site and its operation
- Provide all necessary documentation to explain the technical aspects of the site and its operation. An A1 size electrical layout diagram will be required. Note that it will not be necessary for the AMS-IX auditor to keep or take away hard or soft copies of all the client’s documentation but some copies or extracts of certain documentation will be required so that proof of compliance can be shown to AMS-IX
- Provide a security escort to all relevant parts of the site
- Provide a meeting room where necessary

The audit process usually starts about 9 am and takes most of the day. Experience has shown that it is best to start with a technical meeting to review the documentation available and understand the layout of the site. This is then followed by a physical inspection of the site to see the power train, principal cooling components, computer rooms and support areas, telecommunications entrance points, security systems and fire control methods. Physical measurements will be taken of room dimensions, temperature and humidity at key points around the AMS-IX equipment. In the afternoon the business process documentation will be reviewed.

A report will be produced that compares the physical site and its processes to the AMS-IX standard using the traffic light process as shown below. A draft report will be produced that the applicant will have two weeks to comment against. After the applicant’s comments have been taken into account a final report will be submitted to AMS-IX. If AMS-IX accepts that the technical status of the applicant’s site is suitable to meet the AMS-IX standard then an approval letter will be sent to the applicant stating that that the site is an AMS-IX approved site and that this approval lasts for two years from the date of the last successful audit.

Compliant	/	?	?	Not compliant	X
Meets the specification		Other comments are given		Does not meet the specification	

4 Technical design and implementation

4.1 Location

	Minimum requirements	Audit results and comments
4.1.1	The building must be in an area with flood protection	
4.1.2	The building should be no closer than 0.10 km from a railroad or major interstate highway	
4.1.3	The building must be at least 500 m from a radar transmitter	
4.1.4	The building must be at least 100m from a mobile telephone mast	
4.1.5	The building must be at least 100m from any source of electrical interference	
4.1.6	The building must have adequate access by road and nearby parking facilities	

4.2 Architectural and building requirements

	Minimum requirements	Audit results and comments
4.2.1	Any computer room windows facing east, west or south must be covered to prevent thermal solar gain.	
4.2.2	Computer room not to be located below plumbed areas such as rest rooms, janitor closets, kitchens, laboratories and mechanical rooms unless a flood containment system has been put in place.	
4.2.3	The building must have a dedicated loading area to handle all anticipated deliveries of supplies and equipment.	
4.2.4	The building materials must be non-combustible e.g. brick, concrete, plasterboard etc.	

4.2.5	The computer room height must allow 0.4 m above the equipment rack on a solid floor and 0.4 m above and below a rack for a raised floor	
4.2.6	All floors must be capable of supporting 750 kg equipment racks	
4.2.7	If a raised floor is fitted then it must be at least 400 mm high with air flows not substantially blocked	

4.3 Security and access control requirements

	Minimum requirements	Audit results and comments
4.3.1	Any windows at ground floor level, that allow direct access into the data centre, must be barred	
4.3.2	Security staff per shift to be at least one person per 3000 m ² of the data centre area 24 hours per day.	
4.3.3	Motion detector alarms in computer rooms, M&E plant rooms, telecommunication entrance rooms and, office areas	
4.3.4	Doors into computer rooms to be controlled by pin, swipe card or biometric access	
4.3.5	Main door into the data centre to be controlled by pin, swipe card or biometric access	
4.3.6	Manned security counter with signing-in and badge allocation to visitors	
4.3.7	Digital CCTV monitoring and recording of all external doors to the computer rooms	
4.3.8	No unauthorised persons must be able to enter the computer rooms, M&E plant rooms, telecommunication entrance rooms and office areas	

4.4 Fire precautions, smoke detection and fire suppression

	Minimum requirements	Audit results and comments
4.4.1	Number and location of fire exits according to local codes	
4.4.2	Fire exits to be unblocked, opening in the right direction and with 900 mm wide approach routes	
4.4.3	Emergency lighting to be in place according to local codes or EU Directives	
4.4.4	Exit signage to be in place according to local codes or EU Directives	
4.4.5	Manual call points must be fitted according to local codes	
4.4.6	Walls and doors to the computer room, telecommunications rooms, M&E plant rooms and other critical areas to be fire rated to Netherlands national standards	
4.4.7	The computer room to be protected by two coincident (double-knock) smoke detection systems. At least one system must be an aspirating smoke detector (ASD) monitoring return air flows. The second system must be another ASD device or a combination optical/ionisation detector.	
4.4.8	Other parts of the building must be monitored by an ASD or an optical /ionisation detector	
4.4.9	All of the building's smoke detection systems must be integrated into one common alarm	
4.4.10	Setting off of the alarm must be transmitted to a third party monitoring agency or the fire brigade unless the site has 24/7 engineering or security personnel on site	
4.4.11	The computer room must be protected with a gaseous or water mist fire suppression system	
4.4.12	A gas fire suppression system must be approved by the NFPA2001 (latest edition) standard and not forbidden by the EU 'F Gas' Directive	
4.4.13	The fire suppression system must only be activated by two separate and concurring fire detection systems or by manual activation. The system must	

	also have a manual override. The system must be left in automatic mode.	
4.4.14	Areas protected by a gas fire suppression system must be fitted with adequate overpressure ventilation plates	
4.4.15	A means of rapid ventilation of the area after a fire incident must be in place	
4.4.16	Manual fire extinguishers must be placed at doorways or other relevant points containing CO ₂ or other approved fire suppressant	
4.4.17	All fire related signage must be in place, e.g. gas suppression system warnings on doors, 'actions in the event of fire' notices etc.	
4.4.18	If the computer room, telecommunications room or M&E plant rooms have a sprinkler system or water mist system then it must be of the pre-action type	
4.4.19	Adjoining rooms or buildings to the main data centre location should be protected with a sprinkler system. If they are not then the fire risk of the adjoining building must be assessed and methods to limit fire spread described.	

4.5 Provision of power supplies

	Minimum requirements	Audit results and comments
4.5.1	The site must be fed from a transformer substation dedicated to the data centre and its associated facilities	
4.5.2	Transformers must be in a secured area	
4.5.3	Power cables must enter the building and be terminated in a dedicated electrical switch room containing all necessary switching and metering	
4.5.4	The power available to the site from the mains utility must be at least 20% more than the peak projected load	
4.5.5	At least two standby generators, in a 2N or N+1 configuration, are required to provide power in the event of a mains failure	
4.5.6	The standby generators must be available with at least 24 hours of fuel	

4.5.7	If more than one generator is connected in parallel then an automatic synchronizing device must be fitted with a manual override operation possible	
4.5.8	Operation of the generator will be by an automatic transfer switch that will detect mains failure	
4.5.9	The generator will automatically switch off when mains power is restored unless there are 24/7 engineering personnel on site capable of making technical decisions	
4.5.10	The generator will have manual controls but will be left set to the automatic setting under normal circumstances	
4.5.11	A connection will be made available so that an external generator can be plugged into the main switchboard	
4.5.12	The generator and cabling will be in a secure location adjacent or within the data centre	
4.5.13	The power capacity of the generator will be at least 20% more than the peak projected load	
4.5.14	The ICT equipment will be protected by an Uninterruptible Power Supply, UPS, in a 2N or N+1 manner	
4.5.15	The energy storage mechanism of the UPS will be sufficient that there will be adequate time for the standby generator to start and come on line	
4.5.16	Each UPS will have its own dedicated energy storage medium, e.g. battery string, kinetic energy system etc.	
4.5.17	The UPS will be centralised	
4.5.18	The capacity of the UPS will be greater than the peak projected load. The average running load capacity will not be more than 80% of the UPS capability	
4.5.19	The UPS will be capable of an automatic and manual bypass onto raw mains feed in the event of maintenance requirements or complete UPS failure	
4.5.20	The UPS will distribute power to the ICT equipment via Power Distribution Unit (PDU)switchgear	
4.5.21	Two power cables will be available to each rack location fed from two separate PDUs and UPS	
4.5.22	Equipment racks will be supplied with at least two 16/32 amp single/three phase feeds as required	

4.5.23	The power train feeding the equipment racks will be concurrently maintainable	
4.5.24	Three phase power distribution systems throughout the data centre will be evenly loaded to within 5% of each other and this must be easily measurable at all significant points e.g. UPS output	
4.5.25	Two power strips will be available in each rack each fed from a separate PDU and UPS. Each power strip must have a local current monitoring facility.	
4.5.26	The building will be protected with a lightning protection system	
4.5.29	External plant such as generators and condensers will have all external metalwork earthed so that surge currents cannot enter the building	
4.5.30	The computer room will have an exposed copper main earth terminal that will be the earth reference point for the room	
4.5.31	The following items will connected to the earthing system; all equipment racks, at least every other leg of any floor pedestal arrangement, all metallic cable containment, all electrical switchgear, HVAC units and metallic ducting, all metallic pipes, the exposed structural steel of the building. All metallic items must be earthed according to NEN 50310	
4.5.32	If power is lost to a rack or racks then the system must be able to restart automatically without causing circuit breakers to trip out due to high inrush currents. This may be achieved by using 'soft-start' equipment, automatic sequential start up procedures or by having sufficient overcapacity in the power supply train.	

4.6 Provision of cooling and ventilation

	Minimum requirements	Audit results and comments
4.6.1	The computer room must maintain temperature and humidity control listed below. Battery rooms must be limited to 25°C. The system must maintain this capability at full load and with an external temperature of up to 36°C.	
4.6.2	HVAC equipment shall be connected to the mains input and backed up with a standby generator. All HVAC equipment shall be concurrently maintainable.	

4.6.3	HVAC equipment shall supply cooling capacity in a 2N or N+1 format	
4.6.4	HVAC equipment shall be rated to at least 20% more capacity than the maximum expected steady state load of the computer room even after one CRAC (Computer Room Air Conditioning) unit has failed or been turned off	
4.6.5	Humidity control must be provided	
4.6.6	A ventilation system must be in place to change the air in the computer, telecoms room, plant room at least once per 24 hours	
4.6.7	All incoming air must be filtered according to ISO 14644 Class 8 standard using EN779 F7 filters or ISO 16890 ePM2.5>65% equivalent. Smoke detectors must be fitted to the incoming air, after filtration, which will shut off the air intakes if smoke is detected.	
4.6.8	A means of manually increasing room ventilation must be in place for removal of smoke after a fire incident	
4.6.9	Battery rooms must be ventilated to EN IEC 62485-1. A hydrogen sensor is recommended.	

AMS-IX computer room environmental requirements.

Minimum cold aisle temperature 18° C
 Maximum cold aisle temperature 24° C
 Maximum hot aisle temperature 35° C
 Humidity 30 -60% RH

If there is no defined 'hot aisle-cold aisle' layout in place then measurements will be taken at the air input and air exhaust sections of all appropriate racks.

4.7 Provision of Cabling and cable management

	Minimum requirements	Audit results and comments
4.7.1	A standards-based structured cabling system is to be in place to provide connectivity to every rack for which the data centre operator is responsible for	
4.7.2	All interior cabling shall be of a low flammability type. Any new cabling must	

	be specified as low flammability and zero halogen type. Cables must meet the Construction Products Regulations (CPR) as defined in the Netherlands (NEN 8102) with a minimum Euroclass Rating of Class D. Class C (<i>Groot</i>) or B2 (zeer groot) is preferred. Data centres must have a cable flammability written policy.	
4.7.3	External cables, i.e. flammable construction, shall not be taken more than 5 m into the building before they are terminated or enclosed in a non-flammable conduit system	
4.7.4	Every rack will have access to a cable containment system, above and or below it, that will allow cables to be properly managed between racks	
4.7.5	Data and single phase power cables will be separated by at least 200 mm	
4.7.6	Data and three-phase power cables will be separated by at least 600 mm	
4.7.7	No cable will be trapped in doors, laid out on the floor, strung between racks or forced into right angle bends	
4.7.8	Every cable will have a unique identity label at both ends denoting origin, destination and if necessary, owner	
4.7.9	Every equipment rack will have a unique identity and if necessary, owner's label	
4.7.10	There will be at least one separate telecommunications room or dedicated 'comms' area in the computer room for connecting separate external telecommunications cables inputs	
4.7.11	At least two telecommunications cables will enter the building at least 20 m apart	
4.7.12	Telecommunications rooms or areas will provide; <ul style="list-style-type: none"> • air conditioning and fire protection to the same standard as the computer room • a change from external grade to internal grade cable • overvoltage protection on all incoming copper cables • a clear demarcation between ownership of cables and equipment 	
4.7.13	All cables passing through fire walls will be sealed against fire and smoke to national or EU regulations	
4.7.14	Each equipment rack will provide adequate vertical and horizontal cable management items to prevent patchcords from obscuring any item of equipment	

4.8 Building Management Systems and monitoring

	Minimum requirements	Audit results and comments
4.8.1	The computer room will have at least one general temperature sensor and one general humidity sensor for the room	
4.8.2	Telecommunications and plant rooms will have a general temperature and humidity sensor	
4.8.3	There will be a water sensor under every raised floor, every CRAC unit and every water cooled rack and also in every plant room	
4.8.4	A software-based BMS will monitor <ul style="list-style-type: none"> -every temperature, humidity and water sensor -the status of the fire alarm panel -the status of the security/access control system -the status of the incoming mains and automatic transfer switch -the status of the generators -the status of each UPS and CRAC unit -the status of any fire/smoke control or HVAC dampers -its own status 	
4.8.5	This information will be displayed on a dedicated BMS terminal with graphical interface	
4.8.6	The UPS will have a software based monitoring, reporting and alarm system	
4.8.7	The essential items of the BMS system will have a dedicated UPS supply with at least one hour of battery time or with other power backup methods.	
4.8.8	Essential alarms will connect via an external telecommunications circuit to an agreed list of stakeholders	
4.8.9	The BMS will store historical trends and generate incident logs and reports	
4.8.10	The BMS will be fail safe in that if it should fail it will not affect the operation of any system that it purely monitors	

5 Operational Requirements

Management techniques must be put in place that give operating procedures and protocols that ensure the continuing efficient and reliable operation of the data centre and timely communication to all stakeholders.

5.1 Good work practices in the building

	Minimum requirements	Audit results and comments
5.1.1	The data centre will have one central manned pedestrian entrance and one general loading bay area	
5.1.2	All equipment will be unpacked and assembled in a dedicated 'build' area and not in a live computer room	
5.1.3	There will be a dedicated control room or area. All control and monitoring functions will be connected into and displayed in the control room.	
5.1.4	Evidence of staff training in the event of a fire event must be available	
5.1.5	Fire marshals who will oversee evacuation of the building and other agreed activities must be identified for every shift	
5.1.6	Dutch Working Conditions Decree 2016 (Richtlijnen met betrekking tot arbeidsomstandigheden) Article 7.8 requires adequate light levels in the workplace operating and maintenance points of work equipment should be sufficiently and effectively lit. AMS-IX recommends a minimum of 500 Lux measured approximately 1 m off the floor in front of AMS-IX equipment.	
5.1.7	If sound levels in the AMS-IX area meet or exceed 80 dB then noise warning labels must be visible and ear protection available on the same floor as the AMS-IX equipment	

5.2 Operational Management Documentation required

	Minimum requirements	Audit results and comments
5.2.1	A general operations manual is required that brings together all the operating requirements and settings of the data centre	
5.2.2	All major items of equipment, e.g. UPS, HVAC, generator etc. shall be included in an asset register which will include a settings and operational procedure to include <ul style="list-style-type: none"> • Location • Serial number • Data of procurement • Manufacturer contact details • Maintenance/call out contact details • Service history • Dates of calibration if required 	
5.2.3	A checklist is required of all items that need to be left in an 'automatic' status and where these controls are located, e.g. fire control panel and gas suppression system, activation of standby generator etc.	
5.2.4	Site documentation information to include <ul style="list-style-type: none"> • Electrical single line diagrams • HVAC layout • Building and floor plans • Locations of racks and other major items of equipment • Rack layout • Logical and physical interconnectivity of equipment 	
5.2.5	All documentation is to be 'maintained' as required in an ISO9001 management quality scheme	
5.2.6	The data centre will have a safety operations manual that will detail <ul style="list-style-type: none"> • Safe working at height • Safe use of electricity • Use of laser transmission equipment • Lifting heavy loads 	

	<ul style="list-style-type: none"> • Monitoring of noise in the workplace • Use of barriers around work areas such as missing floor tiles etc. 	
5.2.7	<p>An algorithm chart is required that will detail the cause and effect of all related</p> <ul style="list-style-type: none"> • Fire detection • Alarm states • Activation of gas suppression • Control of dampers • Powering off of power supply equipment • Powering off of HVAC units • Restart procedures 	
5.2.8	A method statement is required detailing how visitors will be identified and escorted around the site	
5.2.9	A method statement is required detailing how external contractors may enter and work on the site and how their work is monitored, controlled and recorded	
5.2.10	A Change Control and Permit to Work system must be in place	
5.2.11	A Service Level Agreement must be in place that explains power availability to AMSIX equipment, environmental limits around AMS-IX equipment and communication methods to AMS-IX during technical incidents.	

5.3 Maintenance procedures

	Minimum requirements	Audit results and comments
5.3.1	Any internal staff involved in maintenance must be trained and qualified to do so. A personal statement must demonstrate how this competence has been achieved e.g., professional/trade qualifications, attendance at manufacturers' training courses etc.	
5.3.2	Any external contractor involved in maintenance must also be able to demonstrate competence by providing details of nationally recognised qualifications and/or approvals from the original equipment manufacturers	
5.3.3	All fire detection and suppression systems must be designed and installed by	

	qualified personnel and designed to national or international standards. The fire safety system contractor must be identified and confirmed that they are approved by the original equipment manufacturers.	
5.3.4	A maintenance log covering all items related to fire detection and suppression must be available for inspection	
5.3.5	All equipment requiring maintenance shall have a maintenance log detailing the equipment, maintenance dates, outcomes, contact details etc. within a Planned Preventative Maintenance Programme, PPM.	
5.3.6	Every room protected by a gas suppression system must be pressure tested to EN 15004-1 and a certificate to that effect to be available proving the room has passed the pressure test within the last 12 months	
5.3.7	All wall penetration fire seals must be labelled and identified and an annual inspection log kept and be available for inspection	
5.3.8	A maintenance and test regime will be in place for the UPS and generator and the system will have been regularly tested with a 'live' load	
5.3.9	The effects of power cuts must be simulated to prove the operation of UPS and generator start up routines. AMS-IX must be notified in advance of these events.	
5.3.10	AMS-IX must be notified of Maintenance on critical items at least one week in advance. AMS-IX preference is for maintenance to be done during 07h00-12h00 (GMT +1h). Incident Management, i.e., to bring a component back into production after a failure, should be done between 00h00 and 07h00 Maintenance. If the data centres maintenance windows deviate from these then AMS-IX must be given formal notification of the normal maintenance windows.	

6 Business Continuity requirements

Recovery plans must be in place that has an established and rehearsed procedure for dealing with any incident that impairs the operation of the data centre and puts in to place a recovery programme.

An ICT continuity programme must

- Understand the threats to, and vulnerabilities of, ICT services
- Identify the potential impacts of disruption to ICT services
- Provide collaboration between data centre staff, internal and external service providers and stakeholders
- Demonstrate competence by credible responses through exercising ICT continuity plans and test ICT continuity arrangements

The data centre must be able to

- Protect the ICT environment through resilient design and best practice engineering
- Detect incidents at the earliest opportunity
- React to an incident in an appropriate manner
- Recover the data processing and communications systems in a prioritised manner
- Operate in a disaster recovery mode until normal operations are possible
- Return to a normal business position

6.1 Incident handling and disaster recovery

	Minimum requirements	Audit results and comments
6.1.1	The data centre must have a risk assessment analysis that details risks, the impact of these risk and the strategy to obviate these risks, e.g. <ul style="list-style-type: none">• Site: fire, flooding• Operations: power supply failure etc.• Personnel: major epidemic etc.• Communications: main cable damage	

6.1.2	Any critical failure or loss of service must be communicated to AMS-IX within five minutes	
6.1.3	Any critical failure or loss of service must be automatically communicated to all relevant personnel, management and other stakeholders within five minutes	
6.1.4	The method of communication to external agencies and stakeholders must be independent of the same critical facilities that have failed e.g. essential monitoring and communications equipment must be powered by an independent battery-backed supply	
6.1.5	A written plan must be in place that details how all alarms states and system failures will be handled by the data centre staff	
6.1.6	All major incidents will be subject to a management review that will detail <ul style="list-style-type: none"> • What the incident was • Where it happened • When it happened • What was the impact on service provision • How was it dealt with • What changes can be made to prevent a similar incident happening again 	
6.1.7	A statement is required that will detail the impact of a sudden and complete loss of power on the ICT equipment and how a restart will be managed	
6.1.8	A 'call list' is to be available which will list all principle staff of the data centre, their function and contact details plus any appropriate suppliers, maintenance companies and emergency services. Contact details must also include 'out-of-hours' contact details and define responsibilities of all the parties.	