

Brandveiligheids rapport

(Fire safety report)

Triton Cell Therapy Facility EU
LEI-310-F-REP-01
DPS

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Versiebeheer (version control)

Date	Description	Version
15 Jun 2021	Ready for building permit	D10032178:10
26 May 2021	Sprinkler requirements updated for review BMS	D10032178:6
21 May 2021	Ready for review BMS	D10032178:3



Triton te Oegstgeest

Toetsing brandveiligheid Bouwbesluit 2012

In opdracht van Arcadis te Maastricht
15 juni 2021

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Bijlagen

- 1 Vluchttijdenberekening**
- 2 BMS Auxiliary System Standard
BMS-ENG-DS-2005 versie 6 Oktober 2017**
- 3 BMS Lighting Systems Standard
BMS-ENG-DS-2010 versie 2 juli 2020**
- 4 BMS Fire Protection System Standard_Ver1
BMS-ENG-DS-2030 versie 5 juni 2020**
- 5 BMS Environmental Control Chambers Facility Standard
BMS-ENG-DS-2040 versie 3 d.d. september 2020**
- 6 UPD sprinklerinstallatie, uitgangspunten document**
- 7 Addendum Solar Photovoltaic Panels on Project Letter dated 8 februari 2021**



1 Inleiding

In opdracht van “Arcadis” wordt door *moBius consult* de advisering ten aanzien van de brandveiligheid verzorgd in het project “Triton”. Ten behoeve van het VO/DO heeft overleg plaats gevonden met de verschillende leden van het ontwerpteam FM Global, BMS de veiligheidsregio en de omgevingsdienst.

Bij die bespreking op 29 april waren aanwezig:

- Michiel Burger (Kuiper Compagnons);
- Theo Selten (moBius Consult);
- Arno Ederveen (veiligheidsregio);
- Hans van der Niet (Veiligheidsregio);
- Ewoud Zandbergen (Omgevingsdienst West-Holland);

De diverse oplossingsrichtingen, die in deze besprekingen aan de orde zijn geweest, zijn in het ontwerp verwerkt.

1.1 Uitgangspunten

Het toetsingskader voor de brandveiligheid in het pand zijn de voor de bouw relevante brandveiligheidsvoorschriften, zoals omschreven in hoofdstuk 2, 6 en 7 van het Bouwbesluit 2012. In het Bouwbesluit 2012 wordt verder verwezen naar direct aangestuurde normen die van toepassing zijn op ontwerp en bouw. Tevens worden er aanvullende eisen gesteld door de opdrachtgever/eigenaar van het gebouw. Deze aanvullende eisen zijn de eisen van BMS (klant) en FM-Global (verzekeringsmaatschappij). **De hoogste eis van in ieder voorschrift van de diverse partijen is van toepassing.**

1.2 Eisen ten aanzien van het ontwerp.

De eisen waaraan moet worden voldaan zijn de Nederlandse eisen, De schadepreventie aanbevelingen van FM-Global en BMS eisen. Hierbij geldt dat de zwaarste eis van toepassing is.

Verificatieverplichting:

Stuur vóór aanschaf en installatie alle ontwerp- en bouwplannen, inclusief de beoogde constructiematerialen, naar FM Global voor Plan Review-services. Aanvullende eisen die de eigenaar BMS stelt.

Verder blijven de Nederlandse eisen ook van toepassing ter controle van het bevoegd gezag, de brandweer en notified bodies.

Voor de certificering van de diverse ontwerpen dienen deze ter goedkeuring te zijn voorgelegd aan:

- Bevoegd gezag en
- Regionale brandweer en
- Inspectie instelling en
- FM Global en
- Opdrachtgever.



1.3 Basisgegevens

- Tekeningen d.d. van KuiperCompagnons projectnummer A20DB067
- FM-Global Factsheets
- BMS-ENG-DS-2005 Auxiliary Systems Standard, versie 6, gedateerd Oktober 2017
- BMS-ENG-DS-2010 Lighting Systems Standard versie 2 gedateerd juli 2020
- BMS-ENG-DS-2030 Fire Protection System Standard_Ver1 versie 5, gedateerd juni 2020
- BMS-ENG-DS-2040 Environmental Control Chambers Facility Standard versie 3 d.d. september 2020

De laatste vier Engelstalige documenten zijn referentiedocumenten en maken geen deel uit van de aanvraag omgevingsvergunning, maar worden als referentie meegestuurd (exclusief FM-Global factsheets). Het ontwerp dient namelijk ook te voldoen aan de hierin gestelde eisen. (Hoogste eis is van toepassing)

De genoemde documenten zijn allemaal bestekstukken waaraan moet worden voldaan.

1.4 Omschrijving gebouw

Locatie: Het gebouw bevindt zich aan de Willem Enthovenstraat te Oegstgeest, kadastraal nummer E-3383.

Op de tekeningen van de architect is per ruimte de functie, het aantal personen en gebruiksoppervlak opgenomen:

- Gebruiksoppervlakte
- Aantal personen per ruimte
- Bouwlaag
- Functie van de ruimte
- Overige eigenschappen per ruimte in relatie tot brandveiligheid

Verdere uitgangspunten, die maatgevend zijn voor de brandveiligheidsmaatregelen:

- Het gebouw wordt opgetrokken uit voornamelijk onbrandbare materialen. (FM-Global datasheets).
- De hoogste vloer ligt op 15,5 m boven maaiveld.
- De hoogste vloer wordt gebruikt als archiefruimte.
- Er wordt een gecertificeerde sprinklerinstallatie toegepast mede gebaseerd op FM-datasheets.
De functie van de sprinklerinstallatie betreft het toepassen van grotere brandcompartimenten en bescherming van de hoofd draagconstructie. Er is daarom sprake van beperkte brandcompartimentering. Alleen ruimten zonder sprinkler zullen brandwerend worden gescheiden, zoals elektrische ruimten (60 of 120 minuten brandwering), en ruimten met grote vuurlast (magazijn) (60 minuten brandwering)
- Laagste peil is begane grond, uitgezonderd delen van het CUB-gebouw.
- Andere bijzonderheden, in het gebouw zijn hygiëne zones van toepassing.
- Het aantal personen per ruimte is aangegeven op de tekeningen van de architect.
- Het gebouw bestaat uit drie bouwlagen.
- Het gebouw ligt vrij van overige bebouwing.
- Het gebouw wordt voorzien van brand- en subbrandcompartimenten.
- In het gebouw wordt niet geslapen.
- De aanwezige personen zijn zelfredzaam.
- De aanwezige personen zijn merendeel bekend met het gebouw.



1.5 Gelijkwaardigheid (artikel 1.3)

Gelijkwaardigheidsbepaling conform artikel 1.3 van het bouwbesluit voor de toepassing van grotere brandcompartimenten.

Er wordt een beroep gedaan op de Gelijkwaardigheidsbepaling conform artikel 1.3 van het Bouwbesluit. Door toepassing van de sprinklerinstallatie conform het UPD, gebaseerd op FM-Global datasheets of schadelopreventie aanbevelingen.

De sprinklerinstallatie is gebaseerd op FM Global datasheets, en waarin FM niet volstaat zijn de NFPA 13 eisen van toepassing. De opdrachtgever voor het ontwerp van het gebouw heeft een pakket brandveiligheidsmaatregelen die uitstijgen boven de eisen die door FM Global en door de Nederlandse regelgeving kunnen worden geëist. Het document van de opdrachtgever is als bijlage toegevoegd ter referentie en niet als deel van de indiening en betreft document BMS-ENG-DS-2030 versie 5, gedateerd juni 2020.

Tevens is er ten aanzien van de installatie een document toegevoegd waarin de installatie eisen staan opgenomen BMS-ENG-DS-2005 Auxiliary Systems Standard

In onderstaand overzicht zijn de extra brandveiligheidsmaatregelen opgenomen.

- Het hele gebouw wordt voorzien van een sprinklerinstallatie met een blustijd van minimaal 120 minuten. Dit betreft het hele gebouw met uitzondering van expliciet genoemde ruimten zoals elektra ruimten. Deze ruimten worden 120 minuten brandwerend uitgevoerd.
- Communicatie-ruimten worden 60 minuten brandwerend uitgevoerd.
- Trappenhuisen worden 60 minuten brandwerend afgeschermd.
- De capaciteit van de sprinklerinstallatie is gebaseerd op de hoogste vuurlast in de grootste ruimte.
- In het brandcompartiment van de sprinkler wordt subbrandcompartimentering toegepast. Dat wil zeggen zelfsluitende deuren zonder WBDBO maar met een rookwering Sa vanwege de toepassing van een sprinklerinstallatie.
- Alle brand- en rookwerende toepassingen moeten FM-approved zijn.
- Cleanrooms worden nagenoeg luchtdicht uitgevoerd. Enige mate van overstroom is noodzakelijk om de cleanroom met overdruk te kunnen laten functioneren. De lucht moet door potentiële openingen stromen.
- Er bevindt zich een 60 minuten brandwerende wand tussen magazijn en cleanrooms.



1.6 Aanvullende aanbevelingen gesteld door FM-Global en de eisen van de opdrachtgever

Hierna is een samenvatting opgenomen van de brandwerende voorziening conform BMS-ENG-DS-2030. Voornoemd document is leidend, onderstaan overzicht is bedoeld om inzicht te krijgen in de maatregelen.

Electrische systemen tabel 4.4.1.

- Hoogspanningsruimtes worden 120 minuten brand- en rookwerend afgeschermd (geen sprinkler) en rookdetectie (VESDA).
- Electra ruimten worden 120 minuten brand- en rookwerend uitgevoerd met rookdetectie, geen sprinkler.
- Grote UPS ruimten worden 120 minuten brand- en rookwerend uitgevoerd met rookdetectie, geen sprinkler.
- Grote UPS batterij systemen worden 120 minuten brand- en rookwerend uitgevoerd.
- Kleine batterij systemen hebben een natte of preaction sprinkler.
- Algemene (kleinere) batterij systemen worden voorzien van (natte of pre actie) sprinkler.
- Dataruimten hebben gasblussing en pre action sprinkler. De gasblussing moet intreden voordat de sprinkler aan kan spreken.

Mechanical and utility ruimten

- Utility ruimtes worden ook voorzien van rookdetectie.
- Aangezien er een sprinkler wordt toegepast wordt de rookcompartimentering gebaseerd op koude rook (Sa).
- Plaatsen voor vorkheftrucks krijgen natte sprinkler.
- HVAC-units krijgen rookdetectie in het retour kanaal.

Kantoren en light hazard omgevingen, uitvoering minimaal OH.

Ruimten die worden voorzien van natte sprinkler:

- Kantoren.
- Kleine keukens, pantry
- Gebieden met beperkte vuurlast.
- Gebieden boven plafonds wanneer er tussen plafond en bovenliggende vloer een te grote ruimte aanwezig is.
- Cafetaria en keukens. Afzuigkappen voor koken vereisen bescherming tegen droge chemicaliën volgens DS2030 Tabel 4.4.1.

Bedien en computerruimten

- Computerruimte gasblussing, inclusief computervloer, NOVEC 1230.
- GMP-datastorage opslag gas, NOVEC 1230



Laboratoria

- Laboratoria, nat sprinklersysteem.

Cleanrooms

- Laboratoria, nat sprinklersysteem, concealed sprinkler, FM approved.

(Brandbare) stoffen

- Opslag voor brandbare stoffen in 60 minuten brandwerende kasten.

Brandbare stoffen worden in principe in brandwerende voorzieningen opgeslagen.

Algemene ruimten

- Algemene ruimten, uitvoeren met nat sprinklersysteem

Biologische en microbiologische ruimten

- Biologische en microbiologische ruimten uitvoeren met natte sprinkler

Temperatuur beheerste ruimten

- Ruimten met temperatuur tussen 20 en 50 graden, natte sprinkler
- Ruimten met temperatuur tussen 2 en 8 graden, natte sprinkler temperatuur beveiligd.
- Walk in diepvriezers -20 tot -40 graden, WBDBO van 120 minuten en rookdetectie. Vooralsnog zijn dit type ruimten niet in het plan voorzien.

Magazijn

- Opslag nat systeem met ESFR-sprinklerkoppen.

Algemene zaken

- Rek opslag ruimten uitvoeren met ESFR-sprinklers.
- Data/computer ruimten worden uitgevoerd met een Novec 1230 gasblussysteem
- Het gebouw heeft geen gasaansluiting en dus ook geen stookruimte.
- De opstelruimte van de sprinklerinstallatie wordt een uur brandwerend uitgevoerd en wordt voorzien van sprinklerbeveiliging.
- De rookwerendheid van de extra beschermde vluchtwegen moet worden gehandhaafd.

Sprinklervoorwaarden

- Het sprinklerontwerp dient afgestemd zijn met andere disciplines die invloed hebben op het gebouw. Paragraaf 3.1.15
- Risico op bevriezing paragraaf 3.1.16 Daar waar risico op bevriezing aanwezig is wordt eerst isolatie/verwarming toegepast. Indien dit niet mogelijk is, wordt een droog sprinklersysteem voorzien. Indien dat niet mogelijk is wordt een waterglycol mengsel toegepast in het sprinklerleidingsysteem.
- 3.1.22 De sprinklerinstallatie onder FM Global datasheets heeft geen life safety functie.



Aanvullende algemene informatie:

4.0 System design basis

Watertoevoer van leidingwaterbedrijf kan bij calamiteiten 1x 81 m3 per uur bedragen. Deze capaciteit wordt gegarandeerd. Het sprinklerwater wordt opgevangen in een aparte ondergrondse tank, met een inhoud van circa 600 m3. (retension tank)

- 4.1.2.6 In totaal worden 2 sprinklerpompen voorzien waarvan ieder pomp 100% van de capaciteit heeft. Een dieselpomp en een elektra pomp of twee dieselpompen. De elektrische pomp fungeert als primaire pomp.
- 4.1.3.1 De sprinklerwatertank bevindt zich ondergronds.
- 4.2.1.1 De sprinklerpompen bevinden zich bij voorkeur in een apart gebouw, los van het te beschermen gebouw. Aan deze eis is ontheffing verleend door FM-Global.

Algemeen sprinklerwater

Al het sprinklerwater wordt opgevangen in een retension tank.

Hiervoor wordt een systeem in het gebouw voorzien dat het sprinklerwater afvoert naar de retension tank.

Locatie sprinklerpompen

Er wordt gebruik gemaakt van shaft sprinklerpomp, zodat deze op peil kunnen worden geplaatst conform verzoek van FM Global. Het waterniveau van de sprinklerbak ligt lager.

De sprinklerruimte is direct van buiten bereikbaar.

De sprinklerwaterbuffer bevindt zich voor een groot deel beneden peil.

De sprinklerpompruimte wordt 60 minuten brandwerend gescheiden van overige ruimten en voorzien van sprinklers.

Schakelruimten

Ruimten met elektrische apparatuur zoals (hoofd)verdelinrichtingen worden niet voorzien van een sprinklerinstallatie, maar van 120 minuten brandwering. Schakelkasten worden gemonitord door een "VESDA" aspiratiesysteem.

Continuïteit

Het gebouw heeft een back-up noodstroomvoorziening waarmee het bedrijf 48 uur onafhankelijk van het Grid kan functioneren. Dit geldt ook voor de noodvoorzieningen. (5 Megawatt voor 48 uren).

Referentie is het BMS-document nummer DS-2030, waar het brandveiligheidsprincipe op is gebaseerd.

Dit document maakt geen onderdeel uit van de aanvraag omgevingsvergunning maar is een toelichting en een guideline voor de installateur.

Inrichting van het compartiment

De brandcompartimenten worden zodanig ingericht, dat aan het gelijkwaardigheidsprincipe wordt voldaan.

Voor de indelingen, zie tekeningen van de architect.

Fire safety BMS

Minimale vrije vluchtwegbreedte bedraagt 91 centimeter





MF-Global datasheets in datasheets

Van toepassing zijnde FM-datasheets. Dit zijn Engelstalige documenten waarvan geen Nederlandse vertaling beschikbaar is. Alle ontwerpen moeten minimaal voldoen aan de eisen gesteld in de FM-datasheets.

Conservation recommendations for the areas and uses of this project can be found in the following sheets

All designs must at least meet the requirements set out in the FM datasheets

- FM-datasheets 1-24, Protection against Liquid Damage
- FM-datasheets 1-20, Protection against External Fire Exposure
- FM data sheets: 7-29, Ignitable Liquid Storage in Portable Containers
- FM data Sheets: 7-32, Ignitable Liquid Operations
- FM data Sheets: 8-9, Storage of Class 1, 2, 3, 4 and Plastic Commodities
- FM-datasheets: 7-36, Pharmaceutical Operations
- FM-datasheets: 3-26, Fire Protection for Nonstorage Occupancies
- FM-datasheets: 1-56, Clean Rooms
- FM-datasheet: 8-1, Commodity Classification.
- FM-data Sheets: 8-29, Refrigerated Storage. Protect walk-in coolers, refrigerators and freezer storage units for pharmaceutical raw materials, intermediates, and finished products in accordance with the Data Sheet.
- FM-datasheets: 3-26, Table 2, The offices are categorized as Hazard Category 1 (HC-1) and should be protected per Data Sheet 3-26-Table 2.
- FM-datasheets: 3-26, Utility rooms and areas (e.g. with HVAC equipment) are categorized as Hazard Category 2 and should be protected per FM Data Sheet 3-26, Table 2.
- FM-datasheets: 3-2, A sprinkler system should preferably be supplied from a separate water tank and fire pump designed and installed according to Global Property Loss Prevention Data Sheet 3-2, Water tanks for fire protection
- FM-datasheets: 8-1, Categorize and classify stored goods, including their packaging and pallets by FM datasheet 8-1, Commodity Classification.
- FM-datasheets: 8-9, Storage of Class 1,2,3 and 4 Plastic Commodities
Protect the storage (rigid stack or rack storage) according to the relevant figures and tables of FMdatasheet 8-9, Storage of Class 1,2,3 and 4 Plastic Commodities.
- FM-datasheets: 8-24, Unused pallets must be protected per FM Data Sheet 8-24, Idle Pallet Storage
- FM-datasheetS: 4-5, Manual firefighting: Provide fire extinguishers in accordance with Data Sheet 4-5, Portable Extinguishers throughout the cleanroom. Do not use dry chemical extinguishers because of the potential for corrosion and/or contamination. Attention should be given to the compatibility of the fire extinguisher agent and the various process chemicals in use.Storage (ambient temperatures) solid pile or rack storage
Note: final choice has yet to be made.
- Spaces with electrical equipment are not provided with sprinklers, these are fire resistant for 120 minutes, except where stated.
- Cleanrooms: feature a wet system that is hydraulically designed to provide a minimum density of 8 mm / min hydraulically over the most remote 280 m2.
The extra 950 l / min hose flow and 60 minutes feed time is not demanded.



- Do not use conseald "sealing" nozzles. Conseald "sealing" sprinklers use a gasket around the sprinkler ceiling plate to seal the small gap between the sprinkler ceiling plate and the ceiling tile.
Additional info: there is a concealed sprinkler head type FM approved, so it will be used in the cleanrooms, to be coordinated in advance with FM-Global.
- Deze consealed sprinklerkoppen moeten ieder jaar worden verwijderd/geïnspecteerd om te voorkomen dat ze vast gaan zitten.
- Do not use extended coverage sprinklers due to the possible delayed response due to the distance between the nozzles in other places.

Algemeen: alle ontwerpen betreffende brandpreventieve maatregelen, toe te passen bouwmaterialen en technische installaties moeten vooraf ter goedkeuring aan FM Global ter goedkeuring worden voorgelegd. Alle bouwmaterialen en isolatiematerialen dienen onbrandbaar te zijn.

Vluchtroute in het brand- rookcompartimenten

De vluchtroutes zullen gaan voldoen aan de prestatie-eisen gesteld in het Bouwbesluit. Het gebouw zal voldoende snel worden ontruimd. De gegevens hiervoor zullen in de tekeningen worden verwerkt. Een berekening is in de bijlage toegevoegd.

Zorgplicht:

Zorgplicht: Installaties moeten functioneren conform de voorschriften adequaat worden gecontroleerd, beheerd en onderhouden. De sprinklerinstallatie moet worden gecertificeerd. Van alle brandpreventieve zaken zoals deuren, brandwerend glas moeten certificaten worden verstrekt ten behoeve van het beheer van het gebouw. Doorvoeringen door brandscheidingen moeten voor de oplevering altijd worden gecontroleerd op de kwalitatief juiste uitvoering, en gebaseerd zijn op certificaten en de juiste WBDBO-eis.

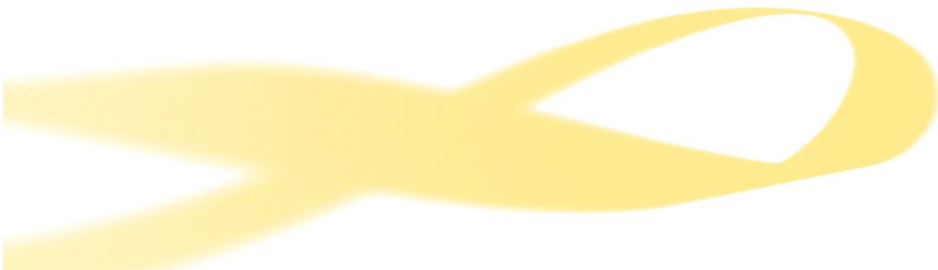
1.7 Ministeriële regelingen

Punten die in een ministeriële regeling zijn opgenomen.

- Subbrandcompartimentering koude rook Sa, opschuimende brandwerende voorzieningen werken niet in een rookscheiding waar sprinkler is voorzien. Ministeriële regeling, NEN 6075.
- Opvang en doorstroomcapaciteit trappenhuizen. Ministeriële regeling in Regeling Bouwbesluit en de NEN 6089.

De ministeriële regelingen, die van toepassing zijn op het ontwerp en de bouw:

- Toepassing normen en certificatie- en inspectieschema's.
- Voorschriften over implementatie richtlijn bouwproducten.
- Kwaliteitsverklaringen voor de bouw.
- Beperking van brand- en rook in een constructieonderdeel.
- Rookdoorgang van subbrandcompartiment naar een andere ruimte, Sa.
- Maatregelen ter voorkoming van toepassing van giftige of hinderlijke en ioniserende bouwstoffen.
- Brandgevaar van aankleding van ruimten.





1.8 Bor, verplichtingen voor de ingebruikname van het gebouw

Omgevingsvergunning brandveilig gebruik conform eisen uit de Bor, artikel 2.2

Gebruiksmelding conform Bouwbesluit

Een gebouw waar meer dan 50 mensen tegelijkertijd aanwezig zijn of een woongebouw voor kamergewijze verhuur, moeten middels een gebruiksmelding voor aanvang van het gebruik van het gebouw worden aangemeld aan de gemeente. De gebruiksmelding dient minimaal 4 weken voor de start van het daadwerkelijke gebruik plaats te vinden. De melding dient conform een landelijk model te worden ingediend. Ook deze gebouwen dienen inclusief de gebruikswijze aan alle eisen conform het gebruiksbesluit te voldoen.

Voor dit gebouw is een gebruiksmelding van toepassing.

1.9 Beschikbaarheid van gegevens

In artikel 1.17 van het Bouwbesluit zijn voorschriften opgenomen voor constructieonderdelen die aanvullend brandwerend zijn behandeld. Materialen en constructies zoals staalconstructies die worden voorzien van een brandwerende coating, brandwerend behandelde materialen en dergelijke, moeten voorzien zijn van een door het bevoegd gezag / brandweer aanvaard document waaruit blijkt dat de aanvullende behandeling adequaat is toegepast. Als er van brandwerende applicaties gebruik wordt gemaakt moet rekening worden gehouden met de eisen in het document “Kwaliteitsrichtlijn applicatie brandwerende coating” van “Bouwen met staal”.





2 Toetsing conform hoofdstuk 2 van het Bouwbesluit

De toetsing aan de brandveiligheid wordt uitgevoerd aan de hand van de eisen uit het Bouwbesluit 2012, hoofdstuk 2. In dit hoofdstuk wordt in de achtereenvolgende paragrafen de relevante eisen uit de brandveiligheidsafdelingen van het Bouwbesluit behandeld.

De beoordeling is gebaseerd op de gebruiksfuncties, bezetting en ruimtesoorten zoals beschreven in hoofdstuk 1. Andere uitgangspunten kunnen leiden tot andere uitkomsten.

2.1 Beperking van uitbreiding van brand (afdeling 2.10)

In deze paragraaf wordt ingegaan op de brandcompartimentering van het gebouw. Op de tekeningen van de architect zijn de begrenzingen van brandcompartimenten aangegeven, inclusief de minimale WBDBO tussen de brandcompartimenten onderling en tussen een brandcompartiment en een extra beschermde vluchtroute. Het van sprinkler voorziene brandcompartiment wordt verder ingedeeld in subbrandcompartimenten. Hierna staan de zaken die zijn gecontroleerd, en indien van toepassing, keuzes die nader zijn gemotiveerd.

De ligging van de brandcompartimenten

De volgende punten zijn gecontroleerd en in orde bevonden:

- Er wordt voldaan aan de eis, dat alle besloten ruimten in een brandcompartiment liggen.
- Er bevinden zich geen stookruimten in het gebouw, er wordt geen gasaansluiting voorzien in de fabrieksplant.
- Technische ruimten (> 50 m²) worden als afzonderlijk brand of rook compartiment uitgevoerd.
- Indien deze ruimten niet van sprinkler worden voorzien wordt een WBDBO van 120/60 minuten voorzien. Zie tekening architect.
- Beschermde vluchtroutes binnen het gebouw zijn uitgevoerd op basis van rookcompartimentering. De omhulling van de trappenhuizen voldoet tevens aan de WBDBO eis, die geldt voor de aanliggende brandcompartimenten en BMS-voorschriften van 60 minuten.
- Er is een extra 60 minuten brandwerende wand tussen magazijn en cleanrooms voorzien. Dit is een FM-global eis.
- Brandgevaarlijke stoffen worden opgeslagen in aparte minimaal 60 minuten brandwerende kasten.
- Een toiletruimte, een badruimte, een liftschacht, indien de constructieonderdelen aan de binnenzijde voldoen aan brandklasse B en rookklasse s2 (conform NEN-EN 13501-1) liggen niet in een brandcompartiment.

Omvang van de brandcompartimenten

Op de tekeningen van de architect is een overzicht gegeven van de omvang van de brandcompartimenten met vermelding van de gebruiksoppervlakten.

- Het gebouw is opgedeeld in enkele brandcompartimenten, hetgeen in een extra brandveiligheid voorziet. Enkele specifieke ruimten zijn brandwerend uitgevoerd. Deze brandcompartimenten zijn kleiner dan 1000 m².



WBDBO van de brandcompartimenten conform de NEN 6068

- De WBDBO van de brandcompartimenten zonder sprinkler is conform Bouwbesluit 2012 eisen minimaal 60 minuten. Echter vanuit gebruiker wordt voor dit gebouw een WBDBO van 120 minuten en 120 minuten met sprinkleractiviteit toegepast:
Uitgezonderd:
De trappenhuizen, die hebben de status van een extra beschermde vluchtroute met een WBDBO van 60 minuten en geen sprinkler.
Elektrische ruimten, die hebben een WBDBO van 120 minuten en geen sprinkler.
Communicatie ruimten, hebben geen WBDBO en maken daardoor deel uit van het gesprinklerd gebied. (Tele datarooms)
Computerruimten hebben een WBDBO van minimaal 60 minuten en zijn voorzien van een gas blus systeem Novec 1230.
Data ruimten hebben een WBDBO van minimaal 120 minuten en zijn voorzien van een gas blus systeem Novec 1230 en een gecommandeerde sprinklerinstallatie.
- Archiefruimte heeft een WBDBO van 120 minuten en gasblussing.
- Verticale schachten, liften en verticale transport/opslag systemen hebben een WBDBO van 60 minuten.
- Op de erfgrans wordt een minimale WBDBO van 60 minuten voorzien. Deze 60 minuten wordt bereikt door de grote afstand tussen de percelen.
- De sprinkler draagt zorg voor de bescherming van de hoofd draagconstructie. (120 minuten)
- In het dak wordt 30 minuten brandwering voorzien vanwege het plaatsen van PV-panelen op het dak. FM Global heeft een algemene projectbrief over zonnepanelen en een algemene verzekeringsbrochure van de Nederlandse verzekeringsinstantie. Deze eisen moeten worden gehanteerd. Hierbij rekening houden met de nieuwe NEN-EN-IEC 62446-1:2016+A1:2018 nl als aanvulling op de NEN 1010.
- De elektra doorvoeringen in het dak worden ook 30 minuten brandwerend uitgevoerd.
- De vluchtroute op het dak vanaf de tweede verdieping naar de beide trappenhuizen dient een minimale sterkte van 30 minuten te bezitten.
- Ondanks de toepassing van sprinkler wordt er toch een 60 minuten brandwering voorzien tussen opslagruimten en cleanrooms. Dit om hoog risico gebieden extra te scheiden. Deze extra brandscheiding komt voort uit de reden dat cleanrooms uiterst gevoelige en kritische ruimtes zijn voor het bedrijf.
- Datacentrums die aan de buitengevel grenzen moeten voorzien zijn van een 2 uur brandwerende gemetselde of betonnen buitengevel. De oostgevel van het datacentrum op de begane grond heeft een betonnen wand met een WBDBO van minimaal 2 uur. Er wordt geen apparatuur tegen die buitenwand geplaatst.

Branddoorslag risico's en sturing

Alle doorvoeringen die een brand- of rookwering doorsnijden dienen overeenkomstig de eisen alle doorvoering van brand- rookwerende applicatie/kleppen te voorzien. De brand- of rookkleppen dienen individueel te kunnen worden aangestuurd (motorgestuurd), zodat alleen de noodzakelijke brand- of rookklep kan worden aangestuurd.

Brandoverslagrisico's

WBDBO bepaalt conform de NEN 6068 met een grenswaarde van 15 kW/m².

Doordat het gebouw van sprinkler is voorzien wordt er geen brandoverslag voorzien.

Vanwege de afstand tot het midden van de openbare weg wordt ook geen brandoverslagrisico naar belendende percelen voorzien.



Zelfsluitende deur tussen Sa- en brandcompartimenten

In alle Sa- en brandwerende scheidingen worden zelfsluitende deuren toegepast.

Ventilatiesystemen en brandcompartimentering

Er dient door de installateur extra aandacht te worden besteed aan doorvoering naar beschermde vluchtroutes om de juiste rookwering te voorzien (met name koude rook). De eisen zijn opgenomen in de NEN 6075: 2020 onder paragraaf 6.3.3. Brand/rookkleppen worden motor gestuurd, uitgevoerd en aangestuurd door de brandmeldcentrale op basis van rookdetectie. De rookdetectie vindt plaats in het retourkanaal. Bij de detectie worden alle bij die HVAC horende brand/rookkleppen dicht gestuurd. De cleanrooms worden "rookdicht" uitgevoerd, uitgezonderd de noodzakelijk overdruk lekkage om aan de hygiëne eisen (sluisfunctie) te kunnen voldoen.

De brand- en rookkleppen zijn van eindstand detectie voorzien.

Opmerking gasgestookte installaties

Het gebouw heeft geen gasaansluiting.

Het ontwerp voldoet aan de in deze paragraaf gestelde eisen.

2.2 Verdere beperking van uitbreiding van brand (afdeling 2.11)

In deze paragraaf wordt ingegaan op de keuze voor de subbrandcompartimentering van het gebouw.

De subbrandcompartimentering wordt bepaald door de maximale loopafstanden die ten behoeve van het vluchten zijn toegestaan. Bij het bepalen van de subbrandcompartimentgrootte wordt rekening gehouden met de gebruiksfunctie en de toegestane vluchtwegafstanden (maximaal en gecorrigeerd), om te voldoen aan de eisen ten aanzien van vluchten. De subbrandcompartimentering is aangegeven op de tekeningen van de architect. Vluchtberekeningen tonen aan dat aan de gestelde eisen wordt voldaan, zie bijlage 6791.08

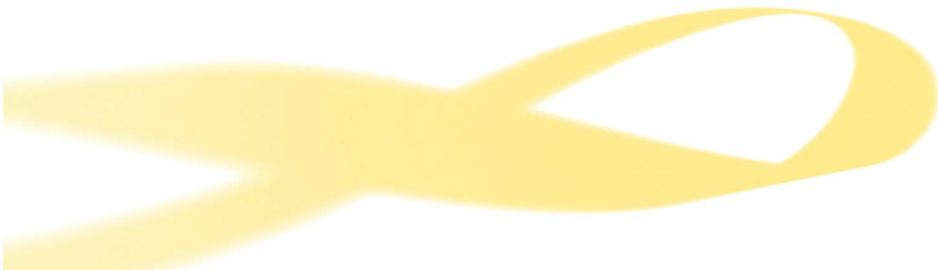
Omvang en loopafstanden binnen subbrandcompartimenten

De omvang van de subbrandcompartimenten zijn bepaald door de toegestane vluchtafstanden afhankelijk van het aantal personen en de vluchtweglengte (conform afdeling 2.12),

Weerstand tegen rookdoorgang op de begrenzing van de subbrandcompartimenten

Met het volgende punt wordt rekening gehouden:

De weerstand tegen rookdoorgang van een subbrandcompartiment naar een besloten ruimte in het brandcompartiment moet worden uitgevoerd, conform de NEN 6068: 2020. Deze maatregel is van toepassing voor alle functies. Aangezien het gebouw van sprinkler is voorzien wordt bij de rookcompartimentering uitgegaan van Sa rookwering uitgevoerd volgens de NEN6075.





Toelichting op aangegeven rook compartimentering cleanrooms en laboratorium. De blauwe lijn is getekend aan de buitenzijde van de cleanroom en laboratorium. De rookscheiding wordt gerealiseerd door de beide deuren van PAL-in en PAL-out (personen in en personen uit). Er is iedere keer maar een deur open, dus de rookwering bestaat uit het geheel PAL-in PAL-out systeem. Het MAL systeem (materiaal in en out) wordt op dezelfde manier gerealiseerd, er is maximaal één deur open.

Het ontwerp voldoet aan de in deze paragraaf gestelde eisen.

2.3 Samengevat staan hier onder de belangrijkste randvoorwaarden:

Brand- rookscheidingen

2.2.2.2. Zorg voor een scheiding van minimaal 1 uur brandwering tussen cleanrooms sectie en het magazijn.

2.2.2.4. Zorg voor onbrandbare bouwmaterialen om de cleanroom te bouwen.

2.2.2.5. Als er locaties zijn waar onbrandbare bouwmaterialen niet toegepast kunnen worden, gebruik dan materialen die voldoen aan FM4884 of FM 4910.

2.2.2.6. t/m 2.2.2.8. Alle doorvoeringen moeten luchtdicht worden uitgevoerd.

2.2.2.11 De constructie van het plafond van de cleanroom bestaat uit of:

- brandscheiding (beton of staal)
- beton aangebracht op stalen constructie
- klasse 1 (geïsoleerd stalen plafond met beperking van brandbare stoffen boven dit plafond en tegelijkertijd toepassing van sprinkler.
- een plafond uitgevoerd met gipsbeplating heeft niet de voorkeur.

2.2.2.13 Gebruik vloestofdichte vloeren boven de cleanroom met een adequate drainage.

2.2.2.16 Gebruik isolatieschalen gemaakt van steenwol of geëxpandeerd glas.

Luchtbehandeling (HVAC)

Iedere cleanroom heeft zijn eigen HVAC systeem.

Eisen waaraan moet worden voldaan zijn:

BMS-ENG-DS-1100 Design standard for engineering design

BMS-ENG-DS-4101 Design standard for facility utility systems

BMS-ENG-DS-4201 Design standard for water and steam systems

BMS-ENG-DS-4301 Design standard for HVAC systems

De cleanrooms worden door de HVAC-installaties onder overdruk gezet. Hierdoor zal er altijd een minimale lek aanwezig zijn. Deze lek is functioneel om het overdruk systeem voor het laboratorium te kunnen laten werken. De rookwering voor de cleanroom is gebaseerd op Sa. Dit betekent dat hierdoor de functioneel noodzakelijke overdruk lekkage kan worden gerealiseerd. Denk hieraan de sluisfunctie die toegang geeft tot de cleanroom.

Zodra er rookdetectie plaatsvindt in de retour van de HVAC-unit, zal deze worden afgeschakeld en zullen de betreffende rook/brandkleppen sluiten die bij de HVAC-unit horen. Zodra er rookdetectie plaatsvindt zal ook het ontruimingsalarm worden aangestuurd. Er wordt in de cleanrooms geen rookevacuatiesysteem voorzien.



Ventilatiesystemen en subbrandcompartimentering

Er dient door de installateur extra aandacht te worden besteed aan doorvoering naar beschermde vluchtroutes om de juiste rookwering te voorzien (met name koude rook). De eisen zijn opgenomen in de NEN 6075. Brandkleppen met smeltlood en andere op temperatuur functionerende brandafsluitingen mogen conform de NEN 6075 niet meer worden toegepast. Brand- en rookkleppen moeten motor gestuurd worden door rookmelders (brandmeldinstallatie).

Wanden van Cleanrooms:

- Gebruik onbrandbare wand- en vloerpanelen en materialen voor binnenaafwerking in cleanrooms. Waar onbrandbare materialen niet kunnen worden gebruikt, gebruik dan materialen die FM-goedgekeurd zijn volgens FM 4882 voor gebruik in cleanrooms of FM Approvals 4910-specificatie getest (4910-vermeld) om te voldoen aan de FM-goedkeuringen
- Dicht alle doorvoeringen van nutsvoorzieningen in massieve onbrandbare vloeren goed af met goedgekeurde brandwerende materialen. Dicht alle doorvoeringen door geklasseerde wandsystemen af met behulp van goedgekeurde brandwerende muurdoorvoeringen
- In de HVAC-systemen bevindt zich geen sprinklerkoppen.

Overige ruimten.

Bij brand of rookdetectie worden de brand/rookkleppen gesloten en de luchtbehandeling uitgeschakeld.

Sturing BrandMeldinstallatie (BMI) en ontruiming

De sturing van de diverse brand-, rookkleppen, deuren enz. worden automatisch aangestuurd vanuit de brandmeldcentrale. De informatie wordt doorgegeven naar het managementsysteem van het gebouw. Het management systeem moet voldoen aan de eisen gesteld in de NEN 2535, waarbij het toegestaan is om vanuit het gebouw beheer systeem de elementen van de brandmeldinstallatie aan te sturen. Dit is een dedicated systeem in/naast het gebouw beheers systeem.

Het ontwerp voldoet aan de in deze paragraaf gestelde eisen.

2.4 Vluchtroutes (afdeling 2.12)

In deze paragraaf wordt het vluchten vanuit een subbrandcompartiment beoordeeld.

Vluchten naar een veilige plaats

Het volgende punt is gecontroleerd en in orde bevonden:

De vluchtroutes leiden naar de openbare weg waarbij geen af te sluiten deuren gepasseerd worden.

Vluchtroute

Op elk punt van een voor personen bestemd gedeelte van een vloer begint een vluchtroute, die leidt naar het aansluitend terrein en daarna naar de openbare weg. De volgende voorschriften zijn van toepassing:

- De loopafstanden binnen de gebruiksgebieden vallen binnen de maximaal toegestane loopafstanden (op basis van aantal aanwezige personen), op basis van werkelijke loopafstand indien de ruimten niet verder wordt ingedeeld (30 meter). Indien minder personen aanwezig zijn mogen de vluchtweglengtes worden vergroot.



- Aangezien er per persoon meer dan 12 m² gebruiksoppervlak aanwezig is mag de vluchtafstand op 45 meter worden gesteld.
- Aangezien er per persoon meer dan 30 m² gebruiksoppervlak aanwezig is mag de vluchtafstand op 60 meter worden gesteld.
- Het maximale hoogteverschil tussen het gebruiksgebied en vluchtdeur mag maximaal 4 meter bedragen.
- Als er meer dan 150 personen in het subbrandcompartiment of/en in de verblijfsruimte aanwezig zijn worden minimaal 2 onafhankelijke vluchtroutes voorzien. Beide uitgangen van de ruimte liggen minimaal 5 meter uit elkaar.
- Een deur draait met de vluchtrichting mee, indien meer dan 37 personen op deze uitgang zijn aanwezig.

Beschermde vluchtroute uit subbrandcompartiment, utiliteit

Opmerkingen:

- Indien direct naar buiten kan worden gevlucht is geen beschermde vluchtroute voorgeschreven.
- Uit het subbrandcompartiment voert één beschermde vluchtroute. Op deze vluchtroute zijn niet meer dan 37 personen aangewezen, waarbij de lengte van de vluchtroute maximaal 30 meter horizontaal door besloten ruimte bedraagt.
- Een besloten ruimte waardoor een beschermde vluchtroute voert heeft een afstand van subbrandcompartiment tot de volgende uitgang op de horizontale vluchtroute van maximaal 30 meter.
- De trappenhuizen zijn ingericht als extra beschermde vluchtroute, omdat deze een hoogteverschil overbruggen van meer dan 8 meter.

Extra beschermde vluchtroute utiliteitsgebouw bij enkelvoudige vluchtroute.

- Uit het subbrandcompartiment voert één extra beschermde vluchtroute. Op deze vluchtroute zijn meer dan 37 personen aangewezen met een maximum van 150 personen, waarbij de lengte maximaal 30 meter bedraagt.
- De trappenhuizen zijn ingericht als extra beschermde vluchtroute, omdat deze verblijfsruimtes ontsluiten die hoger liggen dan 8 meter.

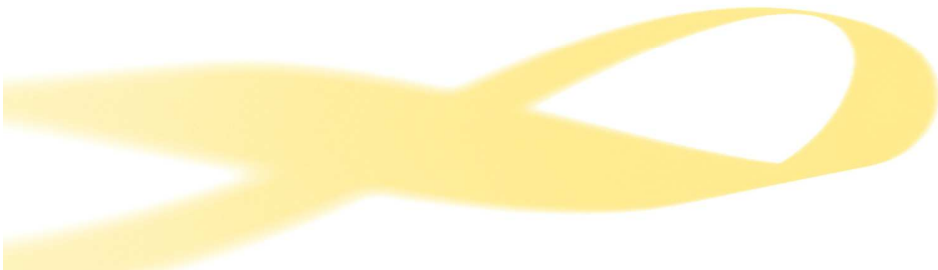
Tweede vluchtroute

Omdat een tweede vluchtroute aanwezig is, hoeft de veiligheidsroute en de extra beschermde vluchtroute en de beschermde vluchtroute niet van toepassing te zijn.

Buiten het brandcompartiment ligt de tweede vluchtroute die niet in hetzelfde brandcompartiment uitkomt.

In afwijking van voorgaande artikelen kunnen twee vluchtroutes vanaf het begin door dezelfde ruimte voeren indien:

- Die ruimte aan de uitgang van het subbrandcompartiment grenst en,
- de vluchtroutes beschermde vluchtroutes zijn en,
- indien deze buiten het brandcompartiment liggen en dan extra beschermde vluchtroutes zijn en,
- de vluchtroute in de besloten ruimte totaal maximaal 30 meter bedraagt in elke richting,
- de vluchtroutes in verschillende richtingen voeren.





Inrichting vluchtroute

- Voor de rookwering naar vluchtwegen gelden extra eisen conform de NEN 6075. De weerstand tegen rookdoorgang tussen een beschermde vluchtroute respectievelijk extra beschermde vluchtroute en aansluitende ruimten bedraagt minimaal 30 minuten Sa.
- De WBDBO tussen een extra beschermde vluchtroute en aansluitende ruimte bedraagt minimaal 60 minuten, dat is van toepassing voor de trappenhuizen.
- De trappenhuizen worden niet voorzien van sprinkler.

Afmeting van de doorgang in een horizontale vluchtroute

Het volgende punt is gecontroleerd en in orde bevonden:

- De breedte (minimaal 0,91 meter) en de hoogte (minimaal 2,30 meter, incidenteel 2,10 meter) van de vluchtdeur (dagmaat).
Let op de maatgevende breedte is de kleinste waarde van de dagmaat van de deur of de afstand tussen klink en tegenovergelegen wand, bij een deur in een gang. Bij een dubbele deur is de maatgevende waarde de kleinste waarde van de dagmaat of de breedte tussen de klinken.

Eisen uit artikel 4.23.

- Een vluchtroute in een toegankelijkheidssector heeft een vrije breedte van minimaal 1,2 meter.

Capaciteit van een vluchtroute

De minimale eis voor een vluchtdeurbreedte bedraagt 85 cm.

De minimale hoogte van een vluchtroute bedraagt 2,30 meter.

De doorstroomcapaciteit duidt op het aantal personen dat per tijdseenheid van een vluchtroute gebruik kan maken. Bepalend hierbij zijn de doorstroomintensiteit en de loopsnelheid. Wat betreft de doorstroomcapaciteit wordt uitgegaan van de volgende rekenregels:

- 45 personen per minuut per meter trapbreedte bij een trap hoger dan 1 meter en 90 personen per meter vrije breedte bij een hoogteverschil van ten hoogste 1 meter voor zover de aantrede minstens 0,17 m bedraagt.
- 90 personen per minuut per meter vrije doorgang bij een vlakke vloer (deur of bordes).
- 90 personen per minuut per meter vrije doorgang bij een dubbele deur met een maximale openingshoek van minder dan 135 graden. (Gemeten in de dag of tussen de klinken van de deur)
- 110 personen per minuut per meter vrije doorgang bij een enkele deur met een openingshoek kleiner dan 135 graden. (Gemeten in de dag of tussen de klink van de deur en de wand)
- 135 personen per minuut bij een vrije breedte van een doorgang zonder deur, of een openingshoek van de deur groter dan 135 graden.

Conform de eisen uit "Regeling Bouwbesluit 2012", paragraaf 2.1 Opvang- en doorstroomcapaciteit wordt rekening gehouden met:

- Een maximale wachttijd bij een subbrandcompartimentscheiding van 3,5 minuten.
- Een maximale wachttijd bij een beschermd subbrandcompartimentscheiding van 6 minuten. E.e.a. is berekend conform de NEN 6089-2011 inclusief wijzigingsblad C1 van 2012.

De berekeningen zijn in de bijlage toegevoegd. De berekeningen tonen aan dat aan de gesteld opvang-, doorstroom en wachttijdeisen wordt voldaan.



Opvang- en doorstroomcapaciteit van een verticale vluchtroute

Het volgende punt is gecontroleerd en in orde bevonden:

- Voor de trappenhuizen is een opvang- en doorstroomcapaciteit en wachttijd berekening bijgevoegd conform Regeling Bouwbesluit. De trappenhuizen voldoen aan de gestelde criteria voor voldoende doorstroom- en opvangcapaciteit en wachttijd van een beschermde vluchtroute.

Basiscapaciteiten:

Voor de opvangcapaciteit wordt uitgegaan van de volgende rekenregels:

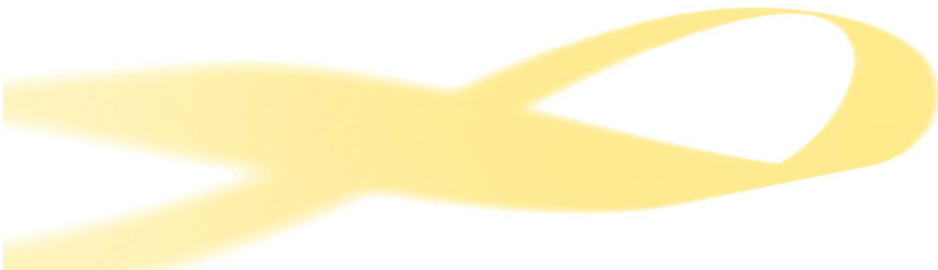
- 4 personen per m² vrije vloeroppervlakte (bordes of vloer in het trappenhuis)
- 2 personen per m² vrije vloeroppervlak indien bij een bijeenkomstfunctie de wachttijd langer is dan 3,5 minuten in het beschermde subbrandcompartiment waarin men moet wachten en er zich meer dan 200 personen in dat subbrandcompartiment bevinden.
- 0,5 personen per traprede, bij een trap als bedoeld in tabel 2.33 van het Bouwbesluit (1 persoon per twee traptreden), niet breder dan 1,1 meter.
- 0,9 personen per meter breedte per traprede, bij een trap als bedoeld in tabel 2.33 van het Bouwbesluit, breder dan 1,1 meter en tredevlak groter dan 0,17 m.
- Berekening conform NEN 6089.
- De berekening is gebaseerd op de opgave van BMS/DPS en gaat uit van 390 personen op enig moment in het gebouw.

Het ontwerp voldoet aan de in deze paragraaf gestelde eisen.

2.5 Trappen (afdeling 2.5)

Een trap is een verticale vluchtroute. In deze paragraaf wordt ingegaan op de voorschriften, die gelden voor de vluchttrappen. De voorschriften voor een trap zijn niet van toepassing voor vluchttrappen vanuit vloeren van technische ruimten, kruipruimtes, bergzolder, vliering of lichte industriefunctie.

- De trappen moeten minimaal voldoen aan de gegevens uit tabel 2.33.
- Door opvang-, doorstroom- en wachttijdberekeningen zijn bredere trappen voorgeschreven.
- Een trap heeft een maximale hoogte van 4 meter.
- Vrije hoogte boven de trap bedraagt 2,1 meter bij utiliteitsfunctie.
- Bij een toegangsdeur dient altijd een bordes te worden voorzien voordat men de deur kan openen. Dit geldt voor beide zijden van de deur. Als voorbeeld de trap voor de vluchttrap op het dak dient buiten van een bordes te worden voorzien en daarna enkel traptreden omlaag om op het dak te komen.





afmetingen van een trap (tabel 2.33 Bouwbesluit)			
	reguliere trap		trap uitsluitend voor ontvluchten
	woonfunctie	andere gebruiksfunctie	alle gebruiksfuncties
Minimum breedte van de trap	0,8 m	0,8 m	0,8 m
Minimum vrije hoogte boven de trap	2,3 m	2,1 m	2,1 m
Minimum aantrede ter plaatse van de klimlijn, gemeten loodrecht op de voorkant van de trede	0,22 m	0,185 m	0,185 m
Maximum hoogte van een optrede	0,188 m	0,21 m	0,21 m
Minimum breedte van het tredevlak, gemeten loodrecht op de voorkant van dat vlak	0,05 m	0,05 m	0,05 m
Minimum breedte van het tredevlak ter plaatse van de klimlijn, gemeten loodrecht op de voorkant van dat vlak	0,23 m	0,23 m	0,23 m
Minimum afstand van de klimlijn tot de zijanten van de trap	0,3 m	0,3 m	0,3 m

Het ontwerp voldoet aan de in deze paragraaf gestelde eisen.

2.6 Hellingbaan (afdeling 2.6)

Indien een hoogteverschil wordt overbrugd door een hellingbaan voor het vluchten van personen (en rolstoelgebruikers) gelden de volgende regels:

1:12 voor een totaal hoogteverschil van maximaal 0,25 meter,

1:16 voor een totaal hoogteverschil liggen tussen 0,25 en 0,5 meter,

1:20 indien het hoogteverschil groter is dan 0,5 meter.

Een hellingbaanbordes heeft de minimale afmetingen van 1,4 x 1,4 meter.

Het ontwerp voldoet aan de in deze paragraaf gestelde eisen.

2.7 Sterkte bij brand (afdeling 2.2)

In deze paragraaf worden de eisen die gesteld worden aan de sterkte bij brand van de bouwconstructie behandeld.

Tijdsduur bezwijken van het gebouw

De volgende punten zijn gecontroleerd en in orde bevonden:

- Een beschermde vluchtroute heeft een sterkte bij brand van minimaal 30 minuten, dit geldt ook voor de constructie boven de vluchtroute. Deze vluchtroute wordt beschermd door de sprinklerinstallatie.



- De sprinklerinstallatie heeft ook als functie, het functiebehoud van de bekabeling van de brandmeld en het aansturen van de ontruimingsinstallatie.
- De sterkte van de constructie wordt voor 120 minuten beschermd door de sprinklerinstallatie, zie UPD sprinklerinstallatie.

Verder gegevens zie rapportage constructeur. De constructeur bepaald de delen van het gebouw die gelden als bouwconstructie.





Brandwerendheidcriteria voor inwendige brandscheidingen conform de NEN 6069.

De criteria zijn:

R: Brandwering op bezwijken van constructies

E: Vlamdichtheid

I: Isolatie (temperatuur, 140⁰ gemiddeld – 180⁰ maximum)

W: Warmtestraling, max 15 kW op 1 meter afstand.

xx: staat voor de brandwerendheidseis van de respectievelijke brandscheidingen

Tabel 2: eisen aan de brandwering

Type brandscheiding	Eis
Tussen brandcompartimenten onderling	Elxx
Tussen sprinkler en ongesprinklerd gebied	Elxx
Rookscheiding	Sa
Tussen brandcompartimenten en de extra beschermde vluchtroute	EWxx
Doorvoeringen	Elxx
Subbrandcompartimenten (rookwerend)	E
Brandwerende daken	RExx of RElxx

Tabel 3: eisen aan de brandwering van beglaasde en beweegbare brandscheidingen

Type inwendige brandscheiding	Eis
Deurconstructie inclusief bovenlichten	EWxx
Glaspanelen in zijlichten (van een deur) die smaller zijn dan 1,5 meter	EWxx + EI15
Glaspanelen in zijlichten (van een deur) die breder is dan 1,5 meter	Elxx brandcompartimenten of EWxx extra beschermde vluchtroutes
Brandschermen en branddeuren	Elxx breder dan 6 meter of EWxx/Elxx afhankelijk van situatie en afstemming met brandweer
Ramen en puiken zonder deuren in brandscheidingen	Elxx brandcompartimenten of EWxx extra beschermde vluchtroutes

Tabel 4: eisen aan de brandwering niet dragende buitengevel

Type brandscheiding	Eis
Brandoverslag brandwering in ontvangende buitengevel vanaf tegenovergelegen buitengevel	EW30 (o -> i)
Brandoverslag brandwering in zendende gevel naar tegenover gelegen buitengevel	EW30 (i -> o)
Brandoverslag brandwering in zendende gevel naar bovengelegen gelegen buitengevel	E30
Brandoverslag bij gereduceerde brandkromme extra aanduiding	-ef

Het ontwerp voldoet aan de in deze paragraaf gestelde eisen.



2.8 Beperking ontwikkeling brand en rook (afdeling 2.9)

In deze paragraaf wordt ingegaan op de maatregelen, die zijn genomen ter beperking van de ontwikkeling van brand en rook. Deze maatregelen zijn gebaseerd op de nieuwbouweisen van afdeling 2.9 van het Bouwbesluit 2012, en de NEN-EN 13501-1.

Bij de materiaalkeuze moet op grond van het Bouwbesluit rekening worden gehouden met de volgende eisen ter beperking van brandvoortplanting en rookproductie:

De verkeersroutes in het gebouw zijn rookwerend afgescheiden van de gebruiksoppervlakken, waarbij de verkeersroutes worden aangekleed conform een extra beschermde vluchtroute.

De aankleding van de diverse ruimten vindt plaats op basis van de onderstaande nederlandse gegevens, tenzij er eisen van de opdrachtgever liggen die hoger zijn (non combustible = onbrandbaar).

Wanden en plafonds binnenoppervlak

- Materialen aan de besloten binnenzijde van een extra beschermde vluchtroute voldoen minimaal aan brandklasse B en rookklasse s2 volgens de NEN-EN 13501-1.
- Materialen aan de besloten binnenzijde van overige ruimten voldoen minimaal aan brandklasse D en rookklasse s2 volgens de NEN-EN 13501-1. Maximaal 10% van de oppervlakte van elke afzonderlijke ruimte is vrijgesteld van de eis met betrekking tot rookklasse.

Elektrische leidingen en pijpisolatie grenzend aan de binnenlucht

- Elektrische leidingen die grenzen aan de binnenlucht in een extra beschermde vluchtroute voldoen minimaal aan brandklasse B2_{ca} en rookklasse s1_(ca) volgens de NEN-EN 13501-6.
- Elektrische leidingen die grenzen aan de binnenlucht in overige ruimten voldoen minimaal aan brandklasse D_{ca} en rookklasse s2_(ca) volgens de NEN-EN 13501-6. Maximaal 10% van de oppervlakte van elke afzonderlijke ruimte is vrijgesteld van de eis met betrekking tot rookklasse.
- Pijpisolatie die grenst aan de binnenlucht in een extra beschermde vluchtroute voldoet minimaal aan brandklasse B₁ en rookklasse s1_(L) volgens de NEN-EN 13501-1.
- Pijpisolatie die grenst aan de binnenlucht in overige ruimten voldoet minimaal aan brandklasse D₁ en rookklasse s2_(L) volgens de NEN-EN 13501-1. Maximaal 10% van de oppervlakte van elke afzonderlijke ruimte is vrijgesteld van de eis met betrekking tot rookklasse.

Vloeren binnenoppervlak

- Materialen op de vloer, trap en hellingbaan van een extra beschermde vluchtroute voldoen minimaal aan brandklasse B_{fl} en rookklasse s1_{fl} volgens de NEN-EN 13501-1.
- Materialen op de vloer, trap en hellingbaan van een beschermde vluchtroute voldoen minimaal aan brandklasse D_{fl} en rookklasse s1_{fl} volgens de NEN-EN 13501-1.
- Materialen op de vloer, trap en hellingbaan van overige ruimten voldoen minimaal aan brandklasse D_{fl} en rookklasse s1_{fl} volgens de NEN-EN 13501-1.

Elektrische leidingen en pijpisolatie grenzend aan de buitenlucht

- Elektrische leidingen die grenzen aan de niet besloten buitenzijde van overige ruimten voldoen minimaal aan brandklasse D_{ca} volgens de NEN-EN 13501-6.



- Pijpisolatie die grenst aan de niet besloten buitenzijde van overige ruimten voldoet minimaal aan brandklasse D₁ volgens de NEN-EN 13501-1.

Overige buitenwanden, exclusief dakvlakken

- Omdat een voor personen bestemde vloer meer dan 5 meter boven meetniveau ligt wordt voor de bekleding aan de buitenzijde rekening gehouden met brandklasse B conform de NEN-EN 13501-1 voor wat betreft de bijdrage tot brandvoortplanting voor de eerste 2,5 meter vanaf peil.
- Constructieonderdelen aan de buitenzijde van het gebouw voldoen boven de 13 meter voor wat betreft de bijdrage tot brandvoortplanting aan klasse B conform de NEN-EN 13501-1.
- De materialen van deuren ramen en andere constructieonderdelen voldoen aan klasse D volgens de NEN-EN 13501-1.

Voornoemde eisen zijn gebaseerd op Nederlandse eisen. FM-Global stelt echter hogere eisen. Het gebouw wordt gebouwd met onbrandbare bouwmaterialen. Mocht er toch voor sandwichpanelen worden gekozen met PU of PIR schuim dan moet er van door FM-Global goedgekeurde panelen gebruik worden gemaakt.

In de uitwerking van de bouwplannen zal met deze randvoorwaarden rekening worden gehouden. Maximaal 5% van het totale oppervlak is vrijgesteld van deze eis (stopcontacten, plinten e.d.).

Dakoppervlak, voorzieningen ten aanzien van de dakafwerking

Met het volgende punt wordt in de besteksfase rekening gehouden:

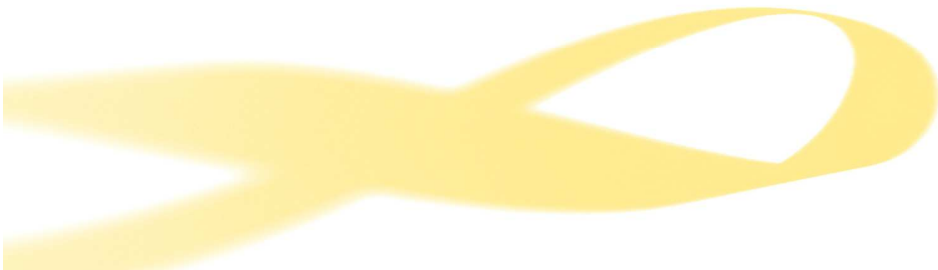
- De dakbedekking en constructie moet voldoen aan FM-Global eisen. (Bitumen is niet toegestaan)
- Een dakconstructie (bijv. Steeldeck / dampremmende laag / isolatie / bovenafdekking) moet FM-goedgekeurd zijn. Dergelijke assemblages zijn te vinden in het RoofNav-programma dat beschikbaar is op www.roofnav.com.
- De dakcomponenten van het bovendeck (dampscherm, isolatie, dakbedekking) moeten mechanisch aan het dek worden bevestigd met behulp van FM Approved bevestigingsmiddelen en spanningsplaten. Onafhankelijk van bovenstaande eisen kunnen nog eisen worden gesteld aan constructieonderdelen middels ministeriële regelingen.

Binnenwanden

FM-Global eisen.

Gebruik onbrandbare wand- en vloerpanelen en materialen voor binnenafwerking in cleanrooms. Als onbrandbare materialen niet kunnen worden gebruikt, gebruik dan materialen die FM-goedgekeurd zijn volgens FM 4882 voor gebruik in cleanrooms of FM Approvals 4910-specificatie getest (4910-vermeld) om te voldoen aan de FM-goedkeuringen

Het ontwerp voldoet aan de in deze paragraaf gestelde eisen.





2.9 Beperking van het ontstaan van een brandgevaarlijke situatie (afdeling 2.8)

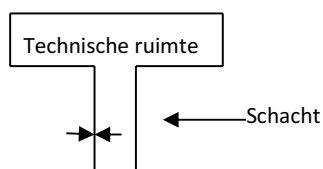
In deze paragraaf wordt ingegaan op de maatregelen ter voorkoming van het ontstaan van brand of een brandgevaarlijke situatie.

Bij aanwezigheid van schachten, kokers of kanalen zijn onderstaande oplossingen van toepassing

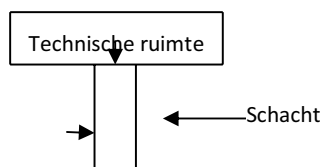
Opmerking:

Aan schachten, die brandwerende wanden en vloeren doorsnijden, worden indien van toepassing eisen gesteld aan de brandwerendheid van materialen. De installateur draagt zorg voor een brandwerende scheiding ter plaatse van doorvoeringen, die brandwerende wanden en vloeren doorsnijden. De waarde van deze brandwerende scheiding is minimaal gelijk aan de waarde van de brandwerende of rookwerende scheiding van de wand of de vloer. Indien van toepassing wordt (een van de) onderstaande uitgangpunten gehanteerd bij schachten respectievelijk doorvoeringen.

Uitvoering schachten en technische ruimte



Indien de schacht bij de technische ruimte hoort dient in de wand van de schacht de brandwering dubbelzijdig (dus van brandruimte naar schacht en van schacht naar brandcompartiment) te worden uitgevoerd.



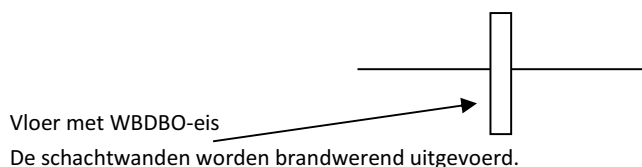
Indien de schacht niet bij de technische ruimte hoort en er geen ontstekingsbronnen in de schacht aanwezig zijn, kan in de wand van de schacht de brandwering enkelzijdig (dus van brandruimte naar schacht) worden uitgevoerd. Van technische ruimte naar schacht wordt dan wel in brandwering voorzien.

Brandwerende schacht of brandscheiding

De uitvoering van de brandwering kan bij schachten op twee manieren plaatsvinden.

Aannemer en installateur moeten voor een van beide uitvoeringen kiezen.

Uitvoering brandwerende schacht

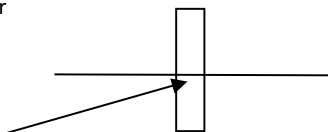




Uitvoering brandwerende vloer

Vloer met WBDBO-eis

Brandscheiding ligt in de vloer, er is geen sprake van een brandwerende schacht



Alle brandwerende doorvoeringen dienen te worden gebaseerd op certificaten die aantonen dat met de uitgevoerde brandwering aan de gestelde eisen wordt voldaan.
Schachten worden ook voorzien van sprinkler.

Het ontwerp voldoet aan de in deze paragraaf gestelde eisen.





3 Toetsing conform hoofdstuk 6 van het Bouwbesluit

De toetsing aan de brandveiligheid wordt uitgevoerd aan de hand van de eisen uit het Bouwbesluit hoofdstuk 6 en betreft installatie van gebouwen. In dit hoofdstuk wordt in de achtereenvolgende paragrafen de relevante installatietechnische eisen uit de brandveiligheidsartikelen van het Bouwbesluit behandeld.

Algemeen, door BMS is een standaard ontwikkeld, namelijk BMS-ENG-DS-2005 Auxiliary Systems Standard Version 6 datet October 2017.

Voor alle installatiewerkzaamheden moet minimaal aan de Nederlandse eisen worden voldaan. Tevens moet minimaal aan de MBS-standaarden worden voldaan, waarbij geldt dat de zwaarste eis van toepassing is.

3.1 Sprinklerinstallatie

De sprinklerinstallatie wordt als gelijkwaardigheid ingezet ter bescherming van het gebouw:

- Toepassing van grote brandcompartimenten
- Functiebehoud van bekabeling BMI en AOI
- Bescherming van de hoofd draagconstructie.
- Als vroegtijdige branddetectie

Uitvoering conform FM Global voorwaarden.

Een gedeelte van de sprinklerinstallatie wordt automatisch aangestuurd, zodat er sprake is van een gecombineerde sprinkler (van toepassing op Data ruimten).

De sprinklerinstallatie moet voldoen aan de FM Global richtlijnen en het document BMS-ENG-DS-2030 Fire protection System Standard_Ver1. Dit document is leidend voor de opzet van UPD en brandveiligheidsrapportage.

- De installatie voldoet aan de FM-Global voorwaarden. De uitvoering is conform een aanvaard Uitgangspunten document (UPD), en gecertificeerd conform het "CCV-schema Inspectie Brandbeveiligingssysteem" van Centrum voor Criminaliteitspreventie en Veiligheid (CCV) te Utrecht" of gelijkwaardig.
- De trappenhuizen worden 60 minuten brandwerend uitgevoerd, zonder sprinkler in de trappenhuizen.
- De sprinklerinstallatie moet minimaal 2 uur kunnen functioneren.
- De onbalans in de installatie moet lager zijn dan 30%.
- In de dataruimten wordt gebruik gemaakt van een gecombineerd sprinklersysteem. Dat wil zeggen wanneer de brandmeldinstallatie (VESDA) een tweede waarschuwingssignaal geeft, dat de sprinklerinstallatie voor die ruimte vrij wordt gegeven, om indien noodzakelijk ook geactiveerd te kunnen worden. Dat signaal wordt van de brandmeldinstallatie naar de sprinklermeldcentrale gestuurd.
- De stroomtoevoer naar een elektrisch aangedreven sprinklerpomp dient voor de hoofdschakelaar van het gebouw af te takken en ook op de noodstroomgenerator aangesloten kunnen worden.
- Het UPD moet vooraf aan de brandweer ter goedkeuring worden voorgelegd.
- Voor het verkrijgen van de omgevingsvergunning zal het UPD aan een certificerende partij ter goedkeuring worden voorgelegd.
- De installatie moet worden gecertificeerd voordat het gebouw in gebruik mag worden genomen.



- De sprinklerinstallatie meldt door naar een continue bezette loge voor de bewakingsdienst (monitor-ruimte).
- In de cleanrooms worden FM approved concealed sprinklerkoppen toegepast. Deze concealed koppen moeten jaarlijks worden onderhouden om te voorkomen dat deze vast gaan zitten. (DS2030-4.4.4.)
- De sprinklermeldcentrale (conform DS2005-4.2.1.21) maakt onderdeel uit van de sprinklerinstallatie en kan de storing en alarm signaleren naar de diverse systemen in het gebouw. Denk hierbij aan toegangscontrolesysteem, sturen van automatische deuren, vrijgeven van deuren die worden dicht gehouden enzovoort. Diverse van die sturingen zijn benoemd in paragraaf 4.5.3 System design.
- Indien de sprinklerinstallatie aanspreekt wordt het alarmsysteem (ontruimingsinstallatie) aangestuurd.
- Constructief: Er dient extra belasting te worden toegevoegd voor de sprinklerinstallatie. Volgens FM Global Standards, met een veiligheidsfactor van niet minder dan 1,0 voor vloiegrens, of 1,25 voor uitieme sterkte; Zorg er echter voor dat de puntbelasting van het ontwerp niet minder is dan 170 kg.
- Er worden shaftpumps toegepast zodat de pompen op base level kunnen staan. De ruimte waarin de sprinklerpompen staan wordt van sprinkler voorzien en 1 uur WBDBO.
- Er is geen doormelding naar de RAC (regionale alarmcentrale), maar wel een doormelding naar een PAC. (particuliere alarmcentrale)

3.2 Elektriciteit en noodstroomvoorziening (afdeling 6.1)

Bij een calamiteit moet nog een goede oriëntatie mogelijk blijven. In deze paragraaf worden de maatregelen opgenomen die hiertoe bijdragen.

Verlichtingssterkte

Met het volgende punt wordt in de besteksfase rekening gehouden:

Een verblijfsruimte, een onder meetniveau gelegen functieruimte, een overige gebruiksfunctie voor personenvervoer met een grootte meer dan 50 m², en een besloten beschermde vluchtroute, heeft een verlichtingsinstallatie die een verlichtingssterkte van ten minste 1 lux kan geven op de totale gebruikte breedte van de bovenzijde van een vloer, van een trap en van een hellingbaan of verkeersroute. Voor de minimaal geëiste verlichtingssterkte zie tabel 4.1.1 in BMS-ENG-DS-2010. Verder moet de verlichting voldoen aan de sturing en normeringen die van toepassing zijn conform BMS-ENG-DS-2010.

Noodverlichting

- Het gehele gebouw wordt voorzien van noodverlichting.
- De noodstroomvoorziening geeft binnen 15 seconden na het uitvallen van de voorziening voor elektriciteit, voldoende stroom om de betrokken verlichtingsinstallatie gedurende ten minste 90 minuten te laten werken en geeft een verlichtingssterkte van minimaal 1 lux op de vloer van een verblijfsruimte, verkeersruimte of trap.
- De noodverlichting wordt voorzien van een centrale noodstroomvoorziening, dus één centrale UPS en geen batterij gevoede armaturen.
- De bekabeling ten behoeve van de noodverlichting dient met functiebehoud en separaat van andere bekabeling te worden gelegd. (1,5 uur)
- Aangezien naastgelegen rook/brandcompartimenten zich gedragen als een (extra) beveiligde vluchtroutes worden alle verkeersruimten/verkeersroutes in het gebouw voorzien van noodverlichting.
- Verdere gegevens, zie rapportage installatieadviseur.



- De noodverlichting moet ook voldoen aan paragraaf 4.2 Emergency Lighting van de BMS-ENG-DS-2010. Met de volgende punten wordt in de besteksfase rekening gehouden:
De noodverlichting wordt uitgevoerd conform de NEN-EN 1838.
De noodverlichting dient tevens te voldoen aan de UL 924.
Let op kleurspecificatie conform BMS-ENG-DS-2010 paragraaf 3.4.
Uitwerken van de installatietekeningen en aan de gemeente ter goedkeuring voorleggen.
Middels een meting moet worden aangetoond dat aan de minimale verlichtingssterkten wordt voldaan.

3.3 Off Grid, electriciteitsvoorziening / generatoren

Het laboratorium moet ook door kunnen functioneren bij stroomuitval.

In het gebouw zal in totaal circa 5 Megawatt elektriciteit worden opgewekt door twee noodstroom aggregaten met CE-keur. De generatoren hebben een CE-keur en zijn daardoor intrinsiek brandveilig uitgevoerd.

Daartoe worden de volgende voorzieningen getroffen:

- 2 generatoren van ieder 2,5 MW met tanks met 30.000 liter dieselinhoud geïntegreerd, CE gemarkeerde units. De installatie wordt gecertificeerd opgeleverd.
- 1 generator van 500 kW t.b.v. de IT-installatie met 2.500 liter diesel geïntegreerd. CE gemarkeerde unit. De installatie wordt gecertificeerd opgeleverd.
- 1 dubbelwandige dieseltank voor de sprinklerpompen van 2.500 liter. Deze moet worden voorzien van normale en noodontluchting en overvul-beveiliging.

De generatoren hebben dubbelwandige tanks. In de laadruimte wordt een oliereceptor geïnstalleerd.

De generatoren worden geleverd als volledig gecertificeerde machines onder de EU CE-richtlijn en hebben ingebouwde brandbeveiligingssystemen (watermist systeem).

De generatoren moeten op temperatuur worden gehouden, dus er moeten verwarmingsvoorzieningen worden getroffen.

De noordelijke gevel van het gebouw wordt gemaakt van onbrandbare materialen en heeft een WBDBO van minimaal 60 minuten om te voldoen aan de eis van 1,5 meter voor niet-brandwerende materialen voor de opstelling van de dieseltank.

Leidingen waar brandstof door wordt gevoerd moeten volledig doorgelast worden uitgevoerd. Leidingen in kwaliteit sch 40 blacksteel.

Algemeen, Raadpleeg de FM-datasheets voor de volledige details over noodgeneratoren (EG) en dieselopslag:

7-88 operaties met ontvlambare vloeistoffen

5-23 Nood- en stand-byvoedingssystemen.

3.4 Brandstoftank en leidingen conform FM-Global

Opslag van de dieselmotorbrandstof in een dubbelwandige stalen tank.

Voorzie de brandstoftank van individuele vul-, aftap- en ontluuchtingsaansluitingen.

Er moet een beveiliging worden voorzien tegen overvulling.

Verleng de tankvul- en ontluuchtingsleidingen naar aansluitpunt. Draag zorg voor een betrouwbare manier om de brandstofopslagtank te onderhouden met een temperatuur boven 40 ° F (4 ° C).



Zorg voor opvang van lekkages rond de brandstoftank om de volledige inhoud van de tank plus 5 cm vrijboord te bevatten.

Gebruik geen glazen of plastic kijkbuizen voor vloeistofpeil op de brandstofopslagtank.

Stel de brandstoftank op maat voor minimaal 8 uur motorlooptijd, plus 5% volume voor expansie en 5% volume voor opvangbak. Reserveer de brandstoftank en brandstof uitsluitend voor gebruik door de brandbluspomp dieselmotor.

Als het onwaarschijnlijk is dat de brandstoftoevoer onmiddellijk wordt aangevuld, zorg dan voor een reservetank ter plaatse met voorzieningen voor brandstofoverdracht naar de voorraadtank.

Zorg voor installaties met meerdere pompen voor afzonderlijke brandstofleidingen en afzonderlijke brandstoftanktanks voor elke motor.

Sluit de brandstoftoevoerleiding niet aan op de bodem van de tank. Zoek de tankaansluiting van de brandstoftoevoerleiding dus 5% van het tankvolume wordt gereserveerd als cartervolume dat niet door de motor kan worden gebruikt. Plaats bovendien de brandstoftoevoerleiding tankaansluiting zodat de relatieve hoogte hoger is dan de motorbrandstofpomp. Controleer dat de maximale statische druk van de brandstofpomp van de motorfabrikant niet wordt overschreden wanneer het brandstofpeil in de tank maximaal is.

Voorzie de genoemde brandstofleiding van een 1/4-slag kogelkraan op het aansluitpunt op de tank. Vergrendel deze klep open. Zorg voor een mechanische bescherming of gebruik beschermde leidingen voor alle blootliggende brandstofleidingen.

Voorzie vlambestendige flexibele brandstofslangen die geschikt zijn voor deze service bij de motor voor aansluiting op de brandstofsysteem leidingen.

Installeer de brandstofretourleiding volgens de aanbevelingen van de motorfabrikant. Installeer geen afsluiters in de brandstofretourleiding naar de tank.

Gebruik alleen het type en de kwaliteit dieselbrandstof zoals gespecificeerd door de motorfabrikant. Zorg voor het minimum vloeipunt en troebelingspunt van de brandstof is 30 ° F (-1 ° C) of lager. Gebruik geen biodieselbrandstoffen vanwege de brandstofstabiliteitsproblemen die bij langdurige opslag ontstaan.

Indien een elektrische magneetklep wordt gebruikt om de brandstoftoevoer van de motor te regelen, zorg ervoor dat deze geschikt is van handmatige mechanische bediening of van handmatige overbrugging in het geval van een storing in het regelcircuit.

Voor specifieke aanbevelingen met betrekking tot de blootstelling aan brand van de dieseltankinstallatie, zie Gegevensblad 7-88, Opslagtanks voor brandbare vloeistoffen voor buiten opgestelde tanks.

Tevens is FM Data Sheet 3-7, Fire Protection Pumps van toepassing.

3.5 Brandmeldinstallatie (afdeling 6.5 artikel 6.20)

Een brandmeldinstallatie draagt bij aan een vroegtijdige ontdekking van brand. In deze paragraaf wordt ingegaan op de voorschriften uit het Bouwbesluit die hiervoor gelden. De basiseis voor dit gebouw is handmatige bewaking.

Brandmeldinstallatie

- Op grond van het Bouwbesluit moet het gebouw worden voorzien van niet automatische bewaking. Bij doodlopende einden wordt automatische detectie toegepast, in ieder geval:
begane grond:
binnen stramien 7 en 10 en as G en midden as ED.
binnen 8,5 en 9 en as D en midden C-D



eerste verdieping:

stramien 6 tussen F en midden HJ

- Bewaking luchtbehandelingskasten, rook respectievelijk brandkleppen
- Op grond van de BMS-richtlijnen wordt op enkele plaatsen automatische bewaking toegepast, hetgeen een hogere eis is dan het Bouwbesluit. Dat betreft:

De volgende rookdetectie wordt voorzien:

- o Elektrische ruimten hebben rookdetectie, laag- en hoogspanningsruimten (VESDA)
 - o Datarooms hebben een eerste, rookdetectie niveau(pre-action VESDA) en blussysteem NOVEC 1230 Dataroom hebben tweede rookdetectie niveau (pre-action VESDA) om de sprinklerinstallatie in deze ruimte te activeren. Deze activatie staat toe dat er een sprinklerblussing plaatsvindt wanneer de sprinklerknoppen stuk springen door de temperatuur.
Dit tweede pre-action signaal moet van de brandmeldinstallatie naar de sprinklerinstallatie worden doorgegeven.
Sprinkler zal automatisch worden geactiveerd met pre-action volgens DS2040 Tabel 4.4.1.
Gasonderdrukking zal normaal gesproken voorkomen dat de sprinkler wordt geactiveerd als dit effectief is. (moet worden geregeld om vóór de sprinklers aanspreken)
 - o HVAC-retour en toevoer rookdetectie voor alle HVAC-units.
De detectie van de toevoer of retour van de HVAC, de AHU zal stoppen en alle rookkleppen in de circuits van het systeem zullen worden gesloten, en er zal een ontruimingssignaal volgen.
 - o Ruimten met UPS hebben 2 uur brandwering en rookdetectie.
 - o Mechanische, interstitiële ruimte en koelruimten. Ruimten die niet door personen zijn bezet conform artikel 4.2.1.14.
 - o Indien deuren op kleefmagneet worden vastgezet moet objectbewaking worden toegepast om bij rookdetectie de deur te laten sluiten.
 - o Als handmelder worden geen pull-stations gebruikt. In plaats daarvan wordt een drukknop met glasplaat gebruikt. Er moet gekozen worden voor types die geen glasresten genereren bij activatie vanwege de hygiëne eisen.
- Er is geen doormelding naar de RAC (regionale alarmcentrale), maar wel een doormelding naar een PAC. (particuliere alarmcentrale)
 - De brandmeldinstallatie geeft een doormelding naar een 24 uur bezette post (Main command centre) in het gebouw.
 - De installatie voldoet aan de NEN 2535, en de NEN-EN 54 reeks. De uitvoering is conform een aanvaard Programma van Eisen (PvE).
 - Het systeem moet een adresseerbaar brandmeldsysteem zijn.
 - Het brandalarmsysteem zal tevens moeten voldoen aan de Nederlandse regelgeving met betrekking tot brandalarm- en detectiesystemen en zal voldoen aan de vereisten van FM Global-vereisten.
 - De brandmeldinstallatie dient tevens te voldoen aan de BS EN9001: ANSI/ASQC Q9001-1994, of gelijkwaardig en de BMW-ENG-DS-2005 Versie 6: design standard for auxiliary systems.
 - Brandmeld en ontruimingssysteem moeten bestaan uit een bedieningspaneel, melder, initiatoren (handmelders, rookmelders, hitemelders, enz.) en indicatieapparatuur (hoorns, flitsers, luidspreker, luidsprekers enz.), indien van toepassing.
 - Aan de buitenzijde van het gebouw bevindt zich een flitslamp bij de toegang voor de brandweer.



- Bij tegenstrijdige eisen tussen BMS voorschriften, FM voorschriften en het Bouwbesluit met ministeriële maatregelen altijd vooraf afstemmen met de opdrachtgever voor de gewenste oplossing.
- Er moet aan de hoogst gestelde eisen worden voldaan.
- De installatie moet worden gebouwd met FM approved onderdelen of gelijkwaardig.
- De toe te passen bekabeling moet met functiebehoud worden uitgevoerd op aparte kabelsysteem los van ander type bekabeling. Er wordt geen gebruik gemaakt van de ontheffing op functiebehoud bij toepassing van een sprinklerinstallatie.
- De brandmeldinstallatie moet communiceren met de andere gebouw gebonden installaties zoals het BAS (Building Automation System), HVAC-systemen, gasdetectiesystemen, interlock systemen (sluis-functies) enzovoort. Alle systemen die worden gekoppeld moeten failsafe worden uitgevoerd met directe contacten. (NO en NC contacten). Volgens DS2005-4.2.1.19 moeten de uitschakelmogelijkheden van rookmelders in het kanaal worden aangesloten op de HVAC-regelapparatuur via hardware NO/NC-contacten. Ook moet, volgens DS2005-4.2.1.18, de brandmeldcentrale een afstandsbediening en uitschakeltoets bevatten om de HVAC te regelen in geval van brand.
- De opdracht nemer moet een document opstellen met eisen verklaringen voor noodstop op om de belangrijkste systemen te identificeren die moeten worden vergrendeld met de activering van het brandbeveiligingssysteem. De ontwerper dient te verwijzen naar de beschikbare documentatie, inclusief Process Hazard Analysis Studies (HAZOP). Volgens DS2030-4.5.2.3 moet een verklaring van eisen van het brandbeveiligingssysteem sleutelsystemen documenteren die moeten worden vergrendeld met aandrijvingen van het brandbeveiligingssysteem.
- De brandmeldinstallatie stuurt ook de ontruimingsinstallatie aan.
- Het Programma van Eisen en de tekeningen van de installatie moeten vooraf aan de brandweer ter goedkeuring worden voorgelegd.
- Het onderhoud aan de brandmeldinstallatie dient conform de NEN 2654-1 plaats te vinden. De eigenaar van het pand zal zorgdragen voor dit onderhoud.
- Indien de omstandigheden dit eisen kan van een aspiratie systeem “VESDA” gebruik worden gemaakt. Dit is van toepassing voor elektrische ruimten.
- De installatie moet worden gebouwd met FM approved onderdelen of gelijkwaardig.
- De minimale stand-by tijd (zonder voeding) moet ook voldoen aan BMS-richtlijn, dat wil zeggen 24 uur standby en 5 minuten alarm.
Verder moet er rekening worden gehouden met de condities van de ruimten (eX).
- Let op in BMS wordt gesproken over ionisatiemelders, die zijn in Nederland niet meer toegestaan, en mogen daarom niet worden toegepast. Een vervangend type is vooraf FM-global en BMS ter goedkeuring voor te leggen. Afhankelijk van de eisen en de omgeving waarin de brandmelders moeten functioneren kunnen optische, hitte of multi-sensor melders worden toegepast.
- Bewaking op doodlopende einden conform het Bouwbesluit.
- Alle beveiligde deuren worden bij een brandalarm direct vrijgegeven.
- De installaties dient met 25% reservecapaciteit te worden ontworpen.

Samenhang tussen brandmeldinstallaties en brand- en rookkleppensturing:

LBK's (Luchtbehandelingskasten) worden elektrisch vergrendeld met het brandmeldsysteem. Dit wordt geïmplementeerd door een adresseerbare I / O-eenheid te gebruiken op het brandalarm lokaal bij de LBK, niet door een rooksensoren die vast is aangesloten op de LBK. Plaats een rook- / brandgebeurtenis, het brandalarm heeft de mogelijkheid om de adresseerbare I / O-units te negeren, waardoor de AHU's kunnen



worden gestart via de BAS. Hierdoor kan de AHU worden geconfigureerd voor volledige verse / volledige dump indien nodig.

- Alle rook- / brandkleppen worden aangestuurd door het brandmeldsysteem, en kunnen worden overruled middels handbediening met schakelaars.
- De status van de rook- / brandkleppen wordt doorgestuurd naar de BAS (gebouw managementsysteem) via een communicatiesignaal, zodat een AHU (Luchtbehandelingsysteem) niet kan starten als de kleppen gesloten zijn.
- De brandmeldinstallatie wordt voorzien van schakelaars om de rook- / brandkleppen per rook- / brandcompartiment te heropenen / overbruggen. Bedieningskast met schakelaars "dicht-auto-open". (gebruik NO NC hardware contacten in failsafe uitvoering. Deze aansturing kan plaatsvinden middels en BAS systeem en middels een schakelpaneel. De brandweer maakt geen gebruik van deze sturingen. De locatie van het schakelpaneel is in de entreehal bij de receptie.
- Het brandalarmsysteem zal ook worden voorzien van sleutelschakelaars om de speciale afzuigventilatoren te starten voor mechanische ventilatie in de Atriums in LOC (2) en de Plant Room in LSCC (1).

3.6 Ontruimingsinstallatie (afdeling 6.6 artikel 6.23)

Een ontruimingsinstallatie zorgt voor een effectieve wijze van waarschuwen bij een calamiteit. In deze paragraaf wordt ingegaan op de voorschriften uit het Bouwbesluit die hiervoor gelden.

- Op grond van het Bouwbesluit/BMS richtlijnen wordt een brandmeldinstallatie voorgeschreven. Daarom wordt er ook een ontruimingsalarminstallatie voorzien. De alarmering bestaat uitgesproken woord én flitsalarmen, gecombineerd.
- De ontruimingsinstallatie moet van een adresseerbaar type zijn.
- De installatie voldoet aan de NEN2575:2012nl. De uitvoering is conform een aanvaard Programma van Eisen (PvE).
- De ontruimingsinstallatie dient tevens te voldoen aan de BS EN9002: ANSI/ASQC Q9001-1994, of gelijkwaardig. Er moet aan de hoogste eisen worden voldaan.
- De toe te passen bekabeling moet met functiebehoud worden uitgevoerd op aparte kabelsysteem los van ander type bekabeling. Er wordt geen gebruik gemaakt van de ontheffing op functiebehoud bij toepassing van een sprinklerinstallatie.
- De installatie moet worden gebouwd met FM approved onderdelen of gelijkwaardig.
- Voor de oplevering van de ontruimingsinstallatie moet middels een (akoestisch) rapport worden aangetoond dat aan de geluidsdrukeisen en zichtbaarheidseisen wordt voldaan bij ruimten die afwijken van de specificaties conform NEN2575.
- De ontruimingsalarminstallatie wordt beheerd, gecontroleerd en onderhouden conform de NEN 2654-2. De eigenaar zal zorgdragen voor dit onderhoud.
- De installatie dient met 25% reserve te worden ontworpen.
- De volgende locaties dienen minimaal worden voorzien van een handbrandmelder:
 - Bij elke brandslanghaspel
 - Bij elke toegangsdeur van elk trappenhuis
 - Bij de receptie van het gebouw
 - En verdere voorschriftelijke plaatsen conform de NEN 2575.
- De ontruimingssignalering start wanneer de retourkanalen van de HVAC rook detecteren.



3.7 Vluchtrouteaanduiding (afdeling 6.6 artikel 6.24)

Vluchtrouteaanduiding draagt bij aan een efficiënte ontruiming van het gebouw bij een calamiteit. In deze paragraaf wordt ingegaan op de voorschriften uit het Bouwbesluit die hiervoor gelden.

- In ruimten waarin meer dan 50 personen aanwezig zijn wordt vluchtroute aanduiding voorzien.
- In verkeersroutes wordt, goed zichtbaar, vluchtrouteaanduiding aangebracht.
- Daar waar noodverlichting wordt geëist, is de vluchtrouteaanduiding uitgevoerd als transparantverlichting conform de eisen gesteld in paragraaf 5.2 tot en met 5.6 van de meest recente NEN- EN 1838 en BMS-CD-004-S27 life Safety paragraaf 24.4.1.
- De noodverlichting dient te worden uitgevoerd conform de NEN 3011:2015nl, en voornoemde eisen bij noodverlichting
- Aan de buitenzijde van een nooduitgang wordt noodverlichting voorzien.
- De grootte van de vluchtrouteaanduiding moet zo zijn dat deze leesbaar zijn vanaf 30 meter.
- Doorgangen die geen vluchtroute zijn, maar wel die indruk kunnen wekken moeten voorzien zijn van een bord "geen vluchtroute".

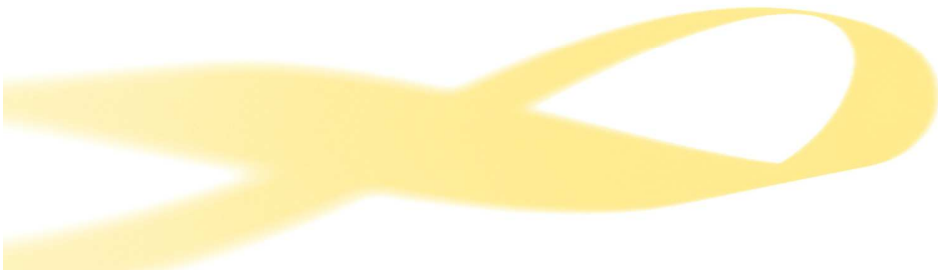
3.8 Deuren in vluchtroutes (afdeling 6.6 artikel 6.25)

Deuren in vluchtroutes moeten aan bepaalde eisen voldoen om het veilig vluchten en de brandwering te waarborgen. Daarvoor moet aan de volgende voorschriften worden voldaan. De eisen zijn middels aanduidingen door de architect op de tekeningen verwerkt.

Met de volgende zaken wordt rekening gehouden.

- Een elektromechanisch vergrendelde vluchtdoor moet voldoen aan de eisen uit de EN 13637.
- Een vluchtdoor draait met de vluchtrichting mee indien meer dan 37 personen op deze uitgang zijn aangewezen vervalst.
- Een nooddeur is geen schuifdeur.
- Een deur waar meer dan 100 personen op zijn aangewezen is met lichte druk te openen of heeft paniekbeslag conform de NEN-EN 1125. Deze worden toegepast op de vluchtdooren van de trappenhuizen naar buiten.
- Beveiligde nooddeuren kunnen met een knop (op 102 tot 122 centimeter hoogte) verticaal boven de vloer en binnen 1,5 meter van de beveiligde deur worden voorzien van een knop om de deur vrij te geven. Er moet een duidelijke aanduiding worden voorzien met de tekst "PUSH TO EXIT" én "DRUK OM DEUR TE OPENEN"
- Buitendeuren worden voorzien van paniekbeslag conform de NEN-EN 1125
- Automatisch werkende deuren mogen het vluchten niet hinderen.
- Een aan de buitenlucht grenzende deur krijgt aan de buitenkant de tekst "nooddeur vrijhouden", conform de NEN 3011.
- Nooddeuren (buitendeuren) moeten met één beweging te openen zijn.

Het toegangssysteem bij de ingang van het gebouw wordt in geval van brandalarm in een open stand gezet.





3.9 Zelfsluitende deuren in vluchtroutes (afdeling 6.6 artikel 6.26)

Eisen gesteld aan deuren in vluchtroutes:

- Deuren in brand- of subbrandcompartimentgrenzen zijn zelfsluitend.

Bovenstaande eisen zijn door de architect in de tekeningen verwerkt.

3.10 Brandslanghaspels (afdeling 6.7 artikel 6.28)

Bij een (beginnende) brand moet deze efficiënt kunnen worden bestreden. In deze paragraaf zijn de maatregelen beschreven die hieraan bijdragen.

Aanwezigheid van brandbestrijdingsvoorzieningen

Er worden brandslanghaspels voorzien in het gehele gebouw. Omdat in het gebouw sprake is van cleanrooms, worden daar geen brandslanghaspels voorzien.

Deze worden buiten de cleanroom voorzien.

Opmerking:

- De brandblusmiddelen zijn aangegeven op de tekeningen van de bouw aanvraag.

Veiligheidsvoorzieningen ten behoeve van de brandbestrijding

De volgende punten zijn gecontroleerd en in orde bevonden:

- De brandslanghaspels worden uitgevoerd conform de NEN-EN 671-1
- De brandslanghaspels hebben een maximale slanglengte van 30 meter.
- Bij gelijktijdig gebruik van twee brandslanghaspels, aangesloten op dezelfde voorziening voor drinkwater, is de statische druk niet minder dan 100 kPa bij een capaciteit van 1,3 m³/h. Voor verdere gegevens zie rapportage installateur.
- De brandslanghaspels moeten duidelijk zichtbaar zijn opgehangen of gemarkeerd worden met een pictogram. (NEN-EN-ISO 7010 van toepassing worden.)

Draagbare blusmiddelen aanvullende eisen.

In het ontwerp wordt ook rekening gehouden met het gebruik van draagbare blusmiddel.

De brandblusmiddelen moet op strategische plaatsen en plaatsen met een brandrisico worden voorzien. Ieder doodlopend einde langer dan 7,5 meter wordt van een draagbaar blusmiddel voorzien, eis van opdrachtgever.

3.11 Sturing luchtbehandelingskasten t.b.v. HVAC-units

FM Global eisen cleanrooms:

Volg de gedetailleerde aanbevelingen van FM Data Sheet 1-56, Clean Rooms voor de volgende onderwerpen:

- Luchtbehandelingssysteem voor cleanrooms
- Cleanroom-rook controle systemen FM Data Sheet 1-56 hoofdstuk 2.3.2.
Voor verdere specificaties zie tekeningen HVAC-installatie.



- Cleanrooms worden niet voorzien van een rookevacuatie systeem.

De installatietechnische voorzieningen moeten voldoen aan de gestelde eisen.

De rookkleppen die de diverse rookcompartimenten door voeren worden voorzien van een motorgestuurde rookkleppen die sluiten op basis van rookdetectie in het retourkanaal. Bij een brandmelding worden deze HVAC-kasten uitgeschakeld.

De "hand-auto-in" schakelingen van de HVAC-kasten kunnen via het BAS (Building Automation System) systeem en door een bedienpaneel worden gestuurd door de eigenaar. Er staan geen schakelaars ter beschikking voor de brandweer.

3.12 Droge blusleiding (afdeling 6.7 artikel 6.29)

Bij een (beginnende) brand moet deze efficiënt kunnen worden bestreden. In deze paragraaf zijn de maatregelen beschreven die hieraan bijdragen.

Aanwezigheid van brandbestrijdingsvoorzieningen

- Aangezien er slechts aan twee zijden hydranten worden voorzien (Oost en Zuid zijde) moeten een droge blusleidingen worden toegepast.
- Het vulpunt van de droge blusleiding bevindt zich aan de oostzijde. Deze leiding steekt in het gebouw over naar de westzijde. Het betreft dus 2 x een droge blusleiding die rechtsreeks oversteekt van ieder van de trappenhuizen Oost naar ieder van de trappenhuizen west.
- Deze water afname punten aan de westzijde bevinden zich op twee plaatsen nabij de uitgangen van de trappenhuizen in de gevel.

Aantal en plaats van brandbestrijdingsvoorzieningen

- Er worden dus twee vulpunten en twee afnamepunten voorzien.

Veiligheidsvoorzieningen ten behoeve van de brandbestrijding

De volgende punten zijn gecontroleerd en in orde bevonden:

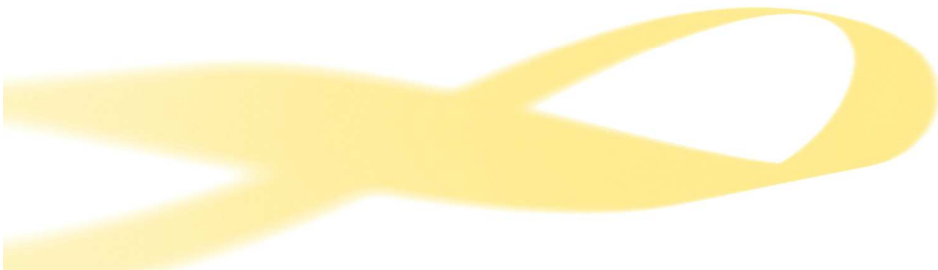
- De droge blusleiding voldoet aan de eisen gesteld in de NEN 1594.
- De loopafstand tussen een brandslangaansluiting van een droge blusleiding en een gebruiksgebied, dat is aangewezen op deze droge blusleiding, bij nieuwbouw niet groter dan 60 meter.

Onderhoud

De eigenaar draagt zorg voor een test van de voorzieningen conform de NEN 1594 minimaal 1 maal per 5 jaar. Dit geldt zowel voor de droge blusleiding als een eventueel noodzakelijk pompinstallatie (drukverhoging).

3.13 Bluswatervoorziening (afdeling 6.7 artikel 6.30)

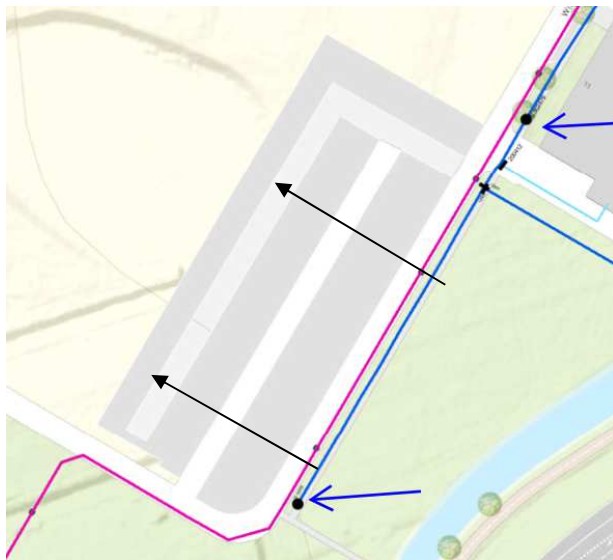
De openbare bluswatervoorzieningen moeten direct bereikbaar zijn en binnen een maximale afstand van het gebouw liggen om snel tot een inzet over te kunnen gaan. Met het waterleverende bedrijf is afgestemd dat er een gegarandeerde maximale toevoer is van 81 m3 per uur, ten behoeve van het vullen van de sprinklertank.





De afstand van de primaire waterwinning tot de brandweeringang van het gebouw bedraagt niet meer dan 40 meter aan de Oost en west-zijde van het gebouw.

Deze openbare bluswatervoorziening moet altijd ter beschikking staan.



Er is een noodvoorziening getroffen op de wateraansluiting. In geval de sprinkler aanspreekt kan een afsluiter om worden gezet waarmee 81 m³ per uur kan worden geleverd. De sprinklertank 600 m³ moet binnen 8 uur gevuld kunnen worden, hetgeen met deze redundante voeding van 81 m³ per uur kan worden gerealiseerd.

3.14 Blustoestellen (afdeling 6.7 artikel 6.31)

Bij een (beginnende) brand moet deze efficiënt kunnen worden bestreden. In deze paragraaf zijn de maatregelen beschreven die hieraan bijdragen. Blustoestellen bieden een aanvullende voorziening in het bestrijden van brand. Een beginnende brand kan door het goede gebruik van een blustoestel in de kiem worden gesmoord. In dit artikel wordt nader ingegaan op de brandveiligheidsmaatregelen middels blustoestellen. De opdrachtgever stel hierbij bovenwettelijk maatregelen.

De brandblusmiddelen moet op strategische plaatsen en plaatsen met een brandrisico worden voorzien. Ieder doodlopend einde langer dan 7,5 meter wordt van een draagbaar blusmiddel (ABC blusser) voorzien. Deze staan aangegeven op de tekeningen van de architect.

De cleanrooms worden vrijwillig voorzien van ABC blussers.

De blussers moeten duidelijk zichtbaar zijn opgehangen of gemarkeerd worden met een pictogram. (NEN-EN-ISO 7010)

Onderhoud

De eigenaar zorg voor 2-jaarlijks periodiek onderhoud van de toestellen conform de NEN 2559.



3.15 Aanduiding brandblusmiddelen (afdeling 6.7 lid 6.33)

Een voorziening voor het bestrijden van brand als bedoeld in de artikelen 6.28 en 6.31 is duidelijk zichtbaar opgehangen of gemarkeerd met een pictogram als bedoeld in NEN 3011.

3.16 Bereikbaarheid voor hulpverleningsdiensten (afdeling 6.8)

Een gebouw dient voor de brandweer snel en efficiënt bereikbaar te zijn, zodat direct tot calamiteitbestrijding kan worden overgegaan.

Brandweertoegang

Het gebouw heeft een brandweeringang namelijk de hoofdingang, deze is aangegeven op de tekeningen van de architect. Het gebouw is 24 uur per dag in gebruik.

Opstelplaats blusvoertuigen.

De opstelplaats voor de blusvoertuigen is op de openbare weg.

De afstand tussen de opstelplaats van het blusvoertuig en de brandweeringang bedraagt maximaal 40 meter.





4 Hoofdstuk 7, gebruik van bouwwerken.

4.1 Voorkomen van brandgevaar en ontwikkeling van brand, inrichting.

Zelfsluitende constructies in vluchtroutes Afdeling 7.1 Artikel 7.3.

Deuren zijn zelfsluitend of zijn van een mechanisme voorzien, dat de deuren doet sluiten in geval van rook-detectie.

Aankleding van een ruimte Afdeling 7.1 Artikel 7.4.

Daar waar een verblijfsgebied of een inrichting van een beschermde vluchtroute is voorzien voldoet de aankleding minimaal aan de voorwaarden gesteld onder artikel 7.4.

Inrichting Afdeling 7.1 Artikel 7.5

Brandveilige inrichting.

4.2 Brandgevaarlijke stoffen Afdeling 7.1 Artikel 7.6

Controle op brandgevaarlijke stoffen.

In de locatie worden brandbare stoffen opgeslagen.

Brandbare stoffen met een hoeveelheid minder dan 50 Kg zijn:

- 2-Propanol, ADR klasse 3, eerste verdieping
- Aceton, ADR klasse 3, eerste verdieping
- 2 maal een opslag van Acetonitrile, ADR klasse 3, eerste verdieping
- DEB instantFOAM NonAlcohol Hand Sanitizer, eerste verdieping
- Ethanol, 200 Proof eerste verdieping
- Methanol op twee plaatsen, ADR klasse 3, eerste verdieping

ADR klasse 3 maximaal toegestane hoeveelheid is 50 kg, dus opslag is toegestaan.

Opslaghoeveelheid minder dan 2000 kg:

- Dimethyl Sulfoxide op 3 verschillende locaties in opslag
- Guanidine Hydrochloride in opslag
- Molecular Biology Grade Ethanol in opslag

De brandbare stoffen moeten worden opgeslagen conform de veiligheidsvoorschriften.

Alle brandbare materialen/stoffen worden opgeslagen in minimaal 60 minuten brandwerende kasten

Buitenopslag dieseltank

De bodembeschermingsmaatregelen volgen uit de Nederlandse Richtlijn Bodembescherming (NRB) en staan benoemd in het Besluit activiteiten leefomgeving (Bal). In het Bal staan maatregelen opgenomen met betrekking tot bodem en water, waaronder het voor een bovengrondse opslagtank inclusief toebehoren verplichte BRL SIKB 7800-installatiecertificaat. Voor stoffen met een vlampunt ≥ 23 °C en ≤ 55 °C wordt verwezen naar deze PGS. Daarnaast is het zo dat er in het Bal voor het item externe veiligheid betreffende dieselopslag niet naar PGS 30 wordt verwezen. Ten opzichte van PGS 30:2011 is veranderd dat bij zowel diesel-installaties als bij kerosine(petroleum)-installaties aanvullende maatregelen worden geëist tegen



overvulling in de in M2 en M71 beschreven situaties. Ook is ten opzichte van PGS 30:2011 veranderd dat bij het afleveren van diesel een vastzetmechanisme op het vulpistool is toegelaten.

4.3 Veilig vluchten bij brand, nieuwbouw

Deuren in vluchtroutes Afdeling 7.2 Artikel 7.10.

Deuren hinderen niet tijdens het vluchten.

Opstelling zitplaatsen Afdeling 7.2 Artikel 7.11.

Opstelling van vaste en tijdelijk geplaatste stoelen bij een bijeenkomst, zodanig dat veilig vluchten gewaarborgd is. (Bijeenkomst, schouwburg, theater, bioscopen, horeca, kantines, kerken, onderwijs, vergaderen en conferentieruimten).

Basiseis:

Van ruimten waarin meer dan 50 personen en/of 10 verminderd zelfredzamen gelijktijdig kunnen verblijven dient ten genoegen van burgemeester en wethouders een opstellingsplan (stoelenplan) aanwezig te zijn.

Opstelling zitplaatsen en verdere inrichting artikel 7.13

In ruimten waarin veel mensen tegelijk bijeenkomen, moet per persoon tenminste het volgende beschikbare vloeroppervlak aanwezig zijn:

- 0,25 m² per persoon zonder zitplaats
- 0,3 m² per persoon bij een vaste zitplaats
- 0,5 m² per persoon bij een losse zitplaats

Voor de bepaling van het beschikbare oppervlak per persoon wordt de oppervlakte die door meubels en versieringen (lager dan 2,50 meter) in beslag wordt genomen, afgetrokken van het bruto beschikbare vloeroppervlak.

Indien in een ruimte meer dan 100 zitplaatsen zijn en die zitplaatsen in meer dan vier rijen van meer dan vier stoelen zijn opgesteld, moeten de stoelen gekoppeld of aan de vloer verbonden zijn. Dit is tevens het geval als de beschikbare vloeroppervlakte per persoon kleiner is dan 0,5 m².

Deze zitplaatsen zijn zo gekoppeld dan wel aan de vloer bevestigd, dat deze ten gevolge van gedrang niet kunnen verschuiven of omvallen. Informatie over de koppeling van zitplaatsen is te vinden in NEN-EN 14703. De stoelkoppeling moet ten genoegen van burgemeester en wethouders zijn uitgevoerd.

De tussenruimte tussen rijen zitplaatsen moet minimaal 40 cm bedragen, gemeten tussen de loodlijnen van de dichtst op elkaar staande gedeelten. De vrije breedte van het gangpad bedraagt tenminste 60 cm. Het maximaal aantal stoelen per rij bedraagt:

- 8 zitplaatsen indien de rij slechts aan één zijde op een gangpad of uitgang uitkomt;
- 16 zitplaatsen, indien de vrije ruimte tussen de rijen kleiner is dan 0,45 meter;
- 32 zitplaatsen, indien de vrije ruimte tussen de rijen groter is dan 0,45 meter;
- 50 zitplaatsen, indien de vrije ruimte tussen de rijen groter is dan 0,45 meter en er bovendien aan beide einden van de rijen een gangpad of een uitgang met een breedte van ten minste 1,10 meter aanwezig is.

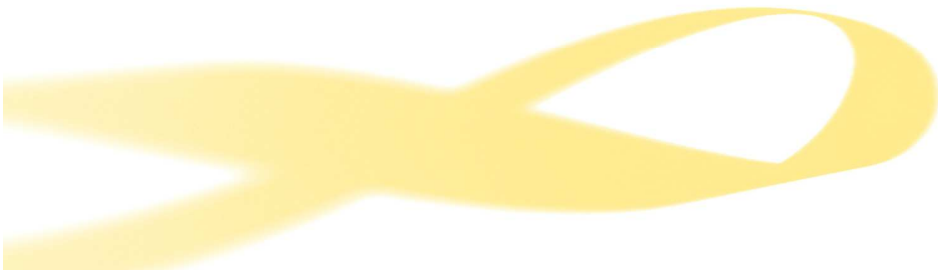


Breedte van de gangpaden

De breedte van gangpaden tussen stands, kramen, schappen, podia en andere inrichtingselementen bedraagt tenminste 1,10 meter. De ruimte voor een uitgang is tenminste even breed en lang als de breedte van de uitgang.

BHV organisatie

Artikel 7.11a: hulpverlening bij brand. Als voor een bouwwerk een vergunning voor brandveilig gebruik verplicht is, of een gebruiksmelding moet worden gedaan, of de functie moet volgens artikel 6.20 voorzien zijn van een brandmeldinstallatie, dan moet er voldoende personeel aanwezig zijn om de ontruiming snel te laten verlopen. De minister wil de invulling van de eis overlaten aan de eigenaar of gebruiker van het gebouw. Hij verwijst naar de bedrijfshulpverlening van de gebruiksfunctie en stelt daarbij dat artikel 7.11a in lijn van de Arbowet is. Voor instellingen die met vrijwilligers werken, betekent het dat ze met een vastgelegd bezettingsplan moeten (gaan) werken.





5 Samenvatting en conclusie

Algemeen

Alle toepassingen die met brandveiligheid te maken hebben dienen met FM-global ter informatie worden verstrekt. Bij geen commentaar kan de uitwerking verder plaatsvinden.

Ten behoeve van besteksfase:

- Controle op toegepaste materialen.
- Controle op materiaalgebruik in relatie tot de eisen gesteld aan gelijkwaardigheid.

Ten behoeve van bouwvoorbereidingsfase:

- De installatietechnische voorzieningen verder uitwerken en afstemmen ter akkoord met brandweer:
 - Noodverlichting
 - Vluchtrouteaanduiding
 - Sprinklerinstallatie (UPD en certificering)
 - Brandmeldinstallatie (PvE)
 - Ontruimingsinstallatie (PvE)
 - Brandslanghaspels
 - Droge blusleiding
 - Draagbare blussers
 - Afstemming aanvalsplan brandweer
 - Goedkeuring locatie brand-hoofdpaneel branddetectie en sprinkler.
- Geen afsluitbare deuren in vluchtroutes toepassen.
- Bij materiaalkeuze bij afwerking van de trappenhuizen rekening houden met brandvoortplantingsklasse en beperkte rookproductie.
- Ten behoeve van de uitvoeringsfase:
 - Controle op de uitvoering van de brandwerende en rookwerende voorzieningen.
- Verkrijgen van alle certificaten behorende bij de brandwerende maatregelen en voorzieningen.
- Certificering van de sprinklerinstallatie.

Ten behoeve van de gebruiksfase:

- Er moet een adequate BHV organisatie aanwezig zijn die bij calamiteiten het ontluchten van het gebouw kan begeleiden.

Driebergen, 15 Juni 2021

ing. Theo Selten



Bijlage

1 Vluchttijdenberekening

Triton te Oegstgeest

Berekening opvang- en doorstroomcapaciteit

Kenmerk: 6791.08

1 Inleiding

In opdracht van Arcadis te Maastricht is de opvang- en doorstroomcapaciteit en de opvangtijd getoetst voor het nieuw te bouwen gebouw Triton te Oegstgeest. Het betreft een gebouw met vijf bouwlagen en vijf trappenhuizen.

2 Uitgangspunten

Voor de berekening is uitgegaan van de onderstaande documenten:

- Tekeningen van DPS, Kuiper compagnons en Arcadis, d.d. 15 juni 2021.
- Brandcompartimentering en bezetting per ruimte zoals weergegeven op plattegronden architect.
- Bouwbesluit 2012, niveau nieuwbouw.
- Regeling Bouwbesluit 2012.
- OntruiMR, Rekenmodel Opvang- en doorstroomcapaciteit en scenarioberekeningen vluchtroutes, Regeling Bouwbesluit 2012, versie X3.4^e, Peutzdata.

Voor de berekening zijn de volgende modeleringen gebruikt:

- Voor het overbruggen van de hoogte van meer dan 4 m (van dak naar 1^e verdieping), zijn er in vier trappenhuizen tussenniveaus aangebracht.
- Er kan niet door de cleaning rooms of de laboratoriumruimte worden gevluht.

3 Gebouwenmerken

Het gebouw bestaat uit magazijn, clean rooms, laboratorium en kantoren en heeft als gebruiksfunctie een kantoorfunctie. Het bestaat uit vijf bouwlagen: kelder, begane grond, mezzanine, 1^e verdieping en dak en is opgedeeld in meerdere brandcompartimenten. Er zijn vijf trappenhuizen die naar de begane grond leiden. Voor de toetsing van de opvang- en doorstroomcapaciteitsberekening is de bezetting gehanteerd zoals deze is aangegeven op de plattegronden van de architect.

4 Eisen en rekenregels

4.1 Maximale ontruimingstijd

De maximale ontruimingstijd is gesteld op:

- 15 minuten indien geen bijzondere voorzieningen zijn getroffen buiten de gestelde eisen
- 20 minuten indien een toegangssluis is toegepast als extra voorziening
- 30 minuten in het geval van een veiligheidsvluchtroute

In dit gebouw bedraagt de maximale toegestane vluchttijd 15 minuten.

4.2 Opvang- en doorstroomcapaciteit

Bij een beginnende brand in één van de subbrandcompartimenten moeten personen het betreffende brandcompartiment binnen 1 minuut ontvlucht zijn. De doorstroomcapaciteit van toegangen naar naastgelegen brandcompartimenten moet voldoen aan de doorstroom en opvangcapaciteitseisen. Een aangrenzende trappenhuis en de eventueel aanwezige opvangruimte moeten over voldoende opvangcapaciteit beschikken om dit te realiseren.

4.3 Opvangtijd

Indien gebruik wordt gemaakt van opvangcapaciteit op vloeren die niet in het trappenhuis zijn gelegen, is de toegestane opvangtijd in deze ruimte conform de Regeling Bouwbesluit 2012 beperkt tot:

- 3,5 minuten indien deze opvangruimte 30 minuten rookwerend is gescheiden van het direct bedreigde compartiment.
- 6 minuten indien deze opvangruimte 30 minuten brandwerend is gescheiden van het direct bedreigde compartiment.

Voor de opvangcapaciteit wordt in deze berekeningen uitgegaan van de volgende rekenregels (regeling Bouwbesluit 2012):

- Hoogteverschil bij trap minimaal 2,1 meter en maximaal 4 meter.
- 2 personen per m² vrije vloeroppervlak opvangcapaciteit bij bijeenkomstfunctie, indien er meer dan 200 personen aanwezig zijn die langer dan 3,5 minuten moeten wachten.
- 4 personen per m² vrije vloeroppervlakte opvangcapaciteit bij de overige functies en bezettingen.
- 0,5 personen per traprede, bij een trap die niet breder is dan 1,1 meter, of tredevlak kleiner dan 0,17 m.
- 0,9 personen per meter breedte per traprede, bij een trap breder dan 1,1 meter en de breedte van het tredevlak groter is dan 0,17m.
- Voor de draairichting van de vluchtdeur geldt dat wanneer op enig moment meer dan 37 personen zijn aangewezen op deze deur (37 personen in de ruimte) deze met de vluchtrichting mee moet openen.
- Er wordt niet door een (sub)brandcompartiment gevlucht welke is bedreigd.

4.4 Doorstroomcapaciteit

Het hele gebouw moet binnen een bepaalde tijd ontruimd zijn. In het algemeen is hiervoor de doorstroomcapaciteit van de vluchttrappen bepalend. Hierbij wordt in de rekenvoorschriften uitgegaan dat de aanwezige personen op de verdiepingen zich in gelijke aantallen verdelen over de beschikbare vluchtwegen.

De doorstroomcapaciteit duidt op het aantal personen dat per tijdseenheid het compartiment kan ontluchten. Bepalend hierbij zijn de doorstroomintensiteit en de loopsnelheid. Wat betreft de doorstroomintensiteit wordt conform Bouwbesluit 2012 uitgegaan van de volgende rekenregels:

- Daalsnelheid in trappenhuis bedraagt 30 seconden per bouwlaag.
- 90 personen per minuut per meter vrije doorgang bij een vlakke vloer (deur of bordes)
- 90 personen per minuut bij een trap voor het overbruggen van een hoogteverschil van ten hoogste 1 meter.
- 45 personen per minuut per meter trapbreedte bij een trap voor het overbruggen van een hoogteverschil van meer dan 1 meter en een aantrede van minimaal 0,17 meter.
- 90 personen per meter vrije breedte van de doorgang bij een dubbele deur met een deuropeningshoek minder dan 135 graden.
- 110 personen per minuut per meter vrije doorgang bij een enkele deur met een maximale openingshoek van minder dan 135 graden.
- 135 personen per meter vrije breedte van een ander doorgang.

5 Scenario's

Indien in een bepaald (sub)brandcompartiment een brand ontstaat kan dan invloed hebben op de vluchtstromen. Er kan namelijk niet door een bedreigd (sub)brandcompartiment worden gevluht. Voor alle subbrandcompartimenten is doorgerekend wat de invloed op het vluchten is, en of binnen de gestelde eisen het gebouw kan worden ontlucht.

Voor alle (sub)brandcompartimenten is uitgerekend of aan de gestelde voorwaarden is voldaan. De berekeningen zijn opgenomen in de bijlage. Hieruit blijkt dat de maximaal toegestane opvangtijden niet worden overschreden.


6 Conclusie

Uit de berekeningen blijkt dat uitgaande van de maximale bezetting van het gebouw wordt voldaan aan de gestelde eisen met betrekking tot opvang- en doorstroomcapaciteit en opvangtijd.

In de bijlagen zijn de rekenresultaten van OntruiMR opgenomen.

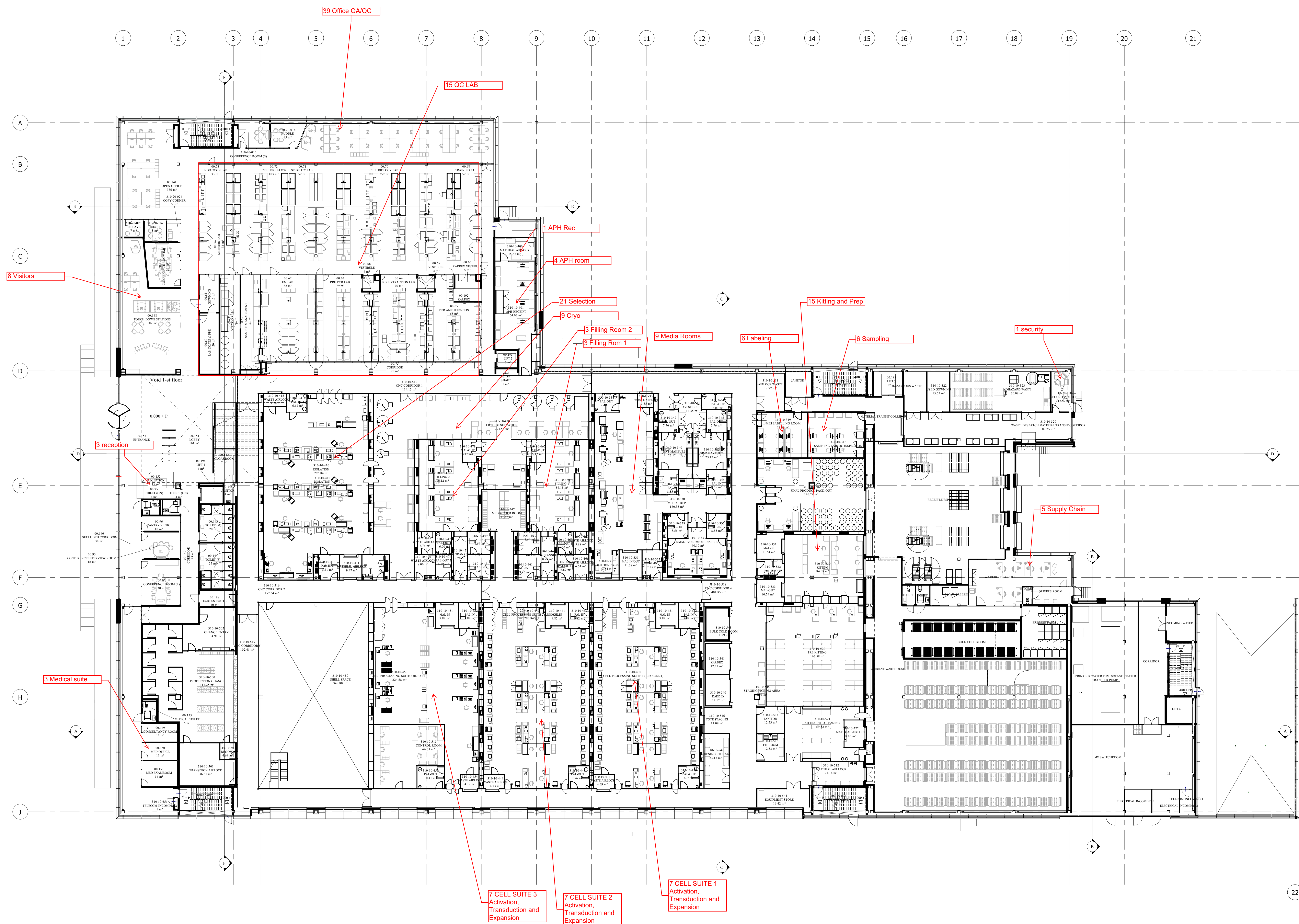
De totale ontruimingstijd bedraagt circa 2,5 minuten bij een scenario-onafhankelijke benadering.
Door toepassing van de aanwezige rook/brandwerende scheidingen tussen de opvangruimten en direct bedreigde compartimenten wordt aan de regelgeving voldaan.

Driebergen, 15 juni 2021

A handwritten signature in black ink, appearing to read 'Theo Selten'. The signature is fluid and cursive, with a large initial 'T' and 'S'.

ing. Theo Selten

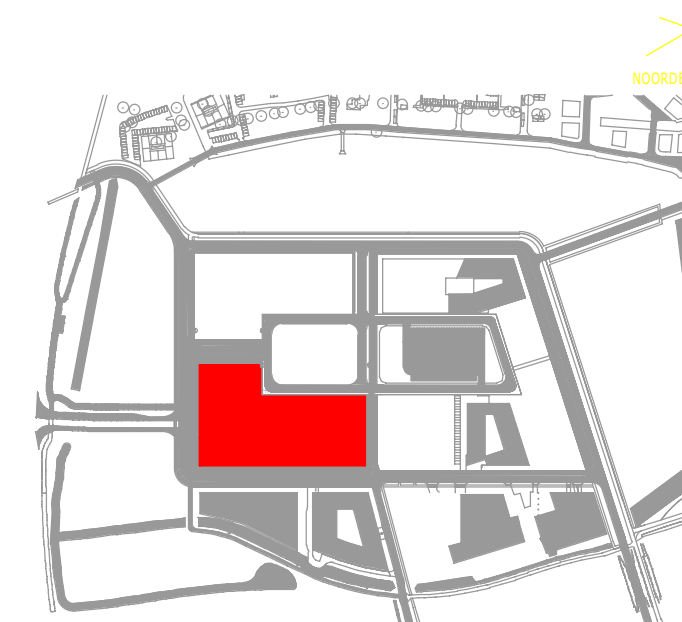
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TOTAL OCCUPANCY 172 GROUND LEVEL

occupancy to be determined by BMS

APPROVED BY:
DRAFTER: KC
PROJECT MANAGER: RK
ENGINEERING MANAGER:
QUALITY ASSURANCE:



1	25/05/2021	LAYOUT FREEZE	MB
REV	DATE	DESCRIPTION	BY
Bristol Myers Squibb			
TITLE: GROUND FLOOR			
PROJECT: EU CELL THERAPY FACILITY			
PHASE:			
LOCATION: LEIDEN BIO SCIENCE PARK NETHERLANDS			
CARP:	DATE:	SHEET:	
SCALE:	1:200	DRAWING #:	
PRJ MGR:	RK	DESIGNER:	KC
VENDOR NAME:	LEI-310-A-10-002		
AUTHOR:	KC		
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SYSTEM:			
EQUIPMENT:			
CSI CATEGORY:			
OBJECT NAME:			
DOCUMENT TYPE:			
DEPARTMENT:			

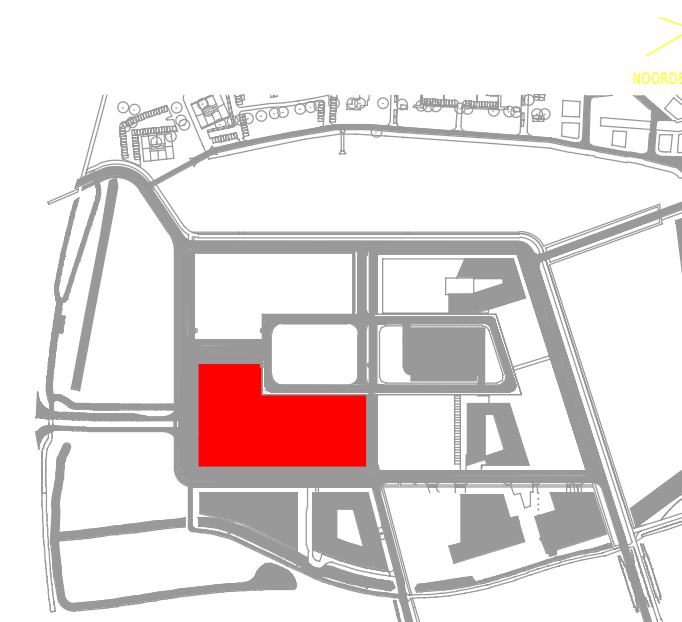
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TOTAL OCCUPANCY 135 1 ST LEVEL

occupancy to be determined by BMS

APPROVED BY:
DRAFTER: KC
PROJECT MANAGER: RK
ENGINEERING MANAGER:
QUALITY ASSURANCE:



REV.	DATE	DESCRIPTION	BY
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Bristol Myers Squibb

TITLE: FIRST FLOOR

PROJECT: EU CELL THERAPY FACILITY

PHASE:

LOCATION: LEIDEN BIO SCIENCE PARK

NETHERLANDS

CARP: SHEET:

DATE: 25/05/2021 SCALE: 1:200 DRAWING #: LEI-310-A-10-003

DESIGNER: KC

VENDOR NAME:

AUTHOR: KC

DISCIPLINE: A

SYSTEM:

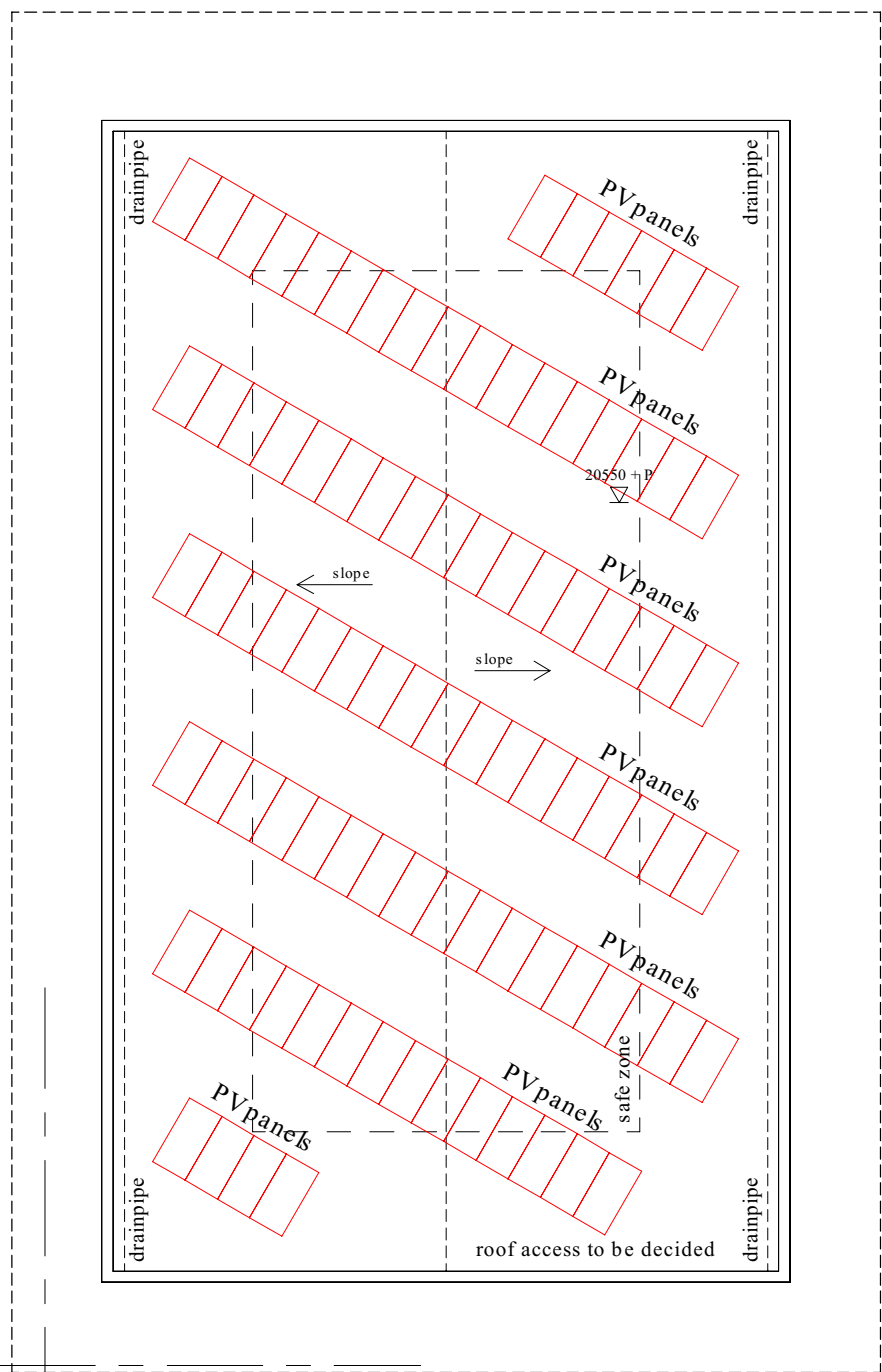
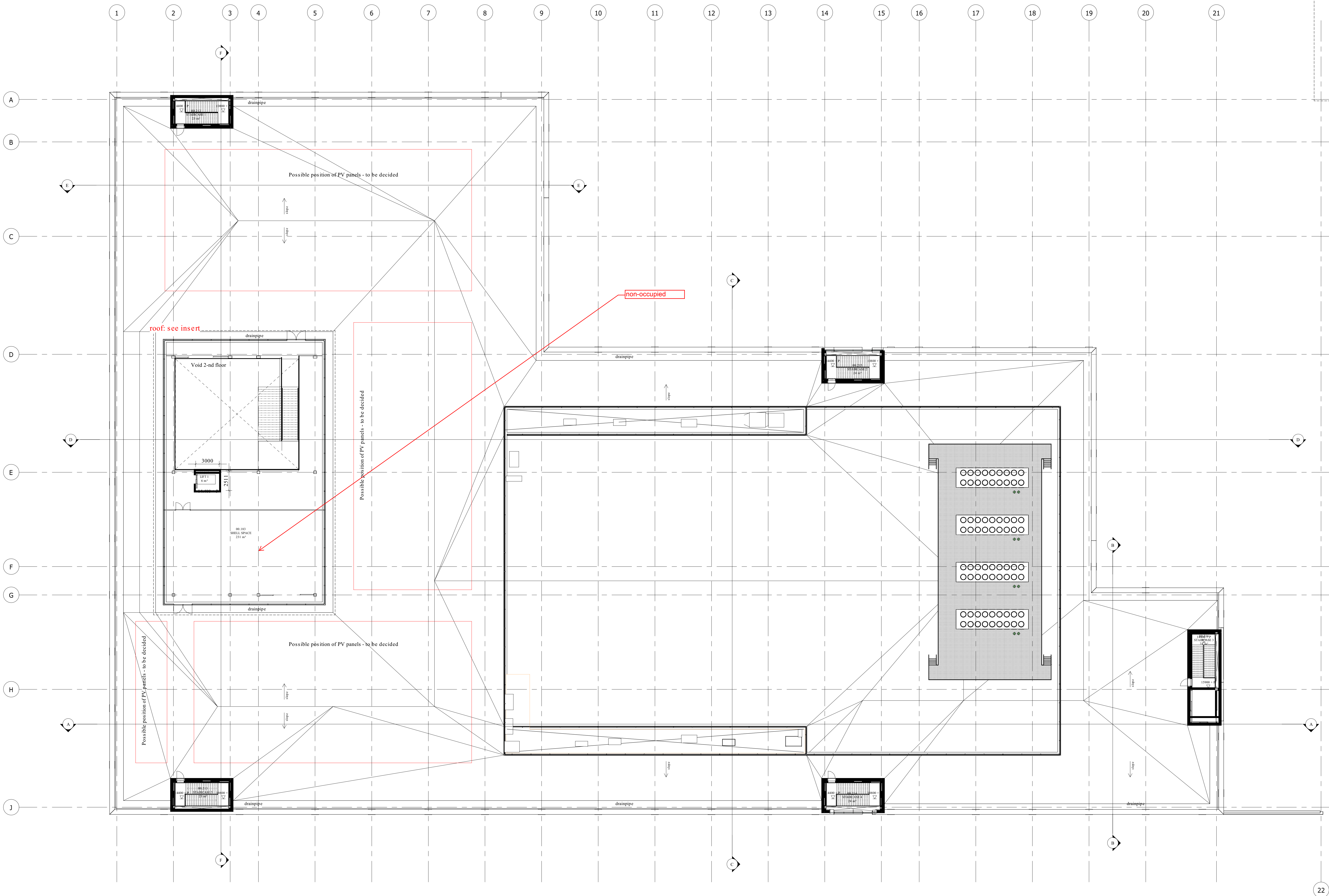
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CSI CATEGORY:

OBJECT NAME:

DOCUMENT TYPE:

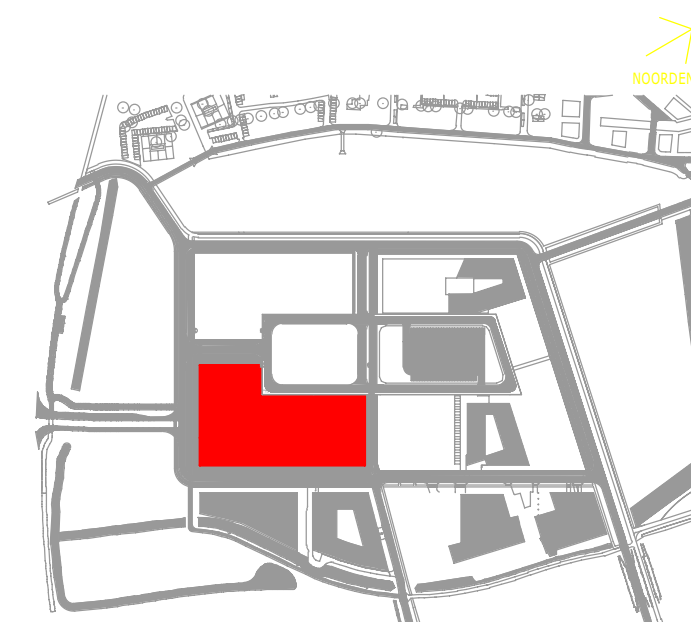
DEPARTMENT:



occupancy to be determined by BMS

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APPROVED BY:
DRAFTER: KC
PROJECT MANAGER: RK
ENGINEERING MANAGER:
QUALITY ASSURANCE:



1	25/05/2021	LAYOUT FREEZE	MB
REV.	DATE	DESCRIPTION	BY

Bristol Myers Squibb

TITLE: SECOND FLOOR

PROJECT: EU CELL THERAPY FACILITY

PHASE:

LOCATION: LEIDEN BIO SCIENCE PARK
NETHERLANDS

CARP: SHEET:

DATE: 25/05/2021

SCALE: 1:200 DRAWING #:

PREP MGR: RK

DESIGNER: KC LEI-310-A-10-004

VENDOR NAME:

AUTHOR: KC

DISCIPLINE: A

SYSTEM:

EQUIPMENT:

CSB CATEGORY:

OBJECT NAME:

DOCUMENT TYPE:

DEPARTMENT:

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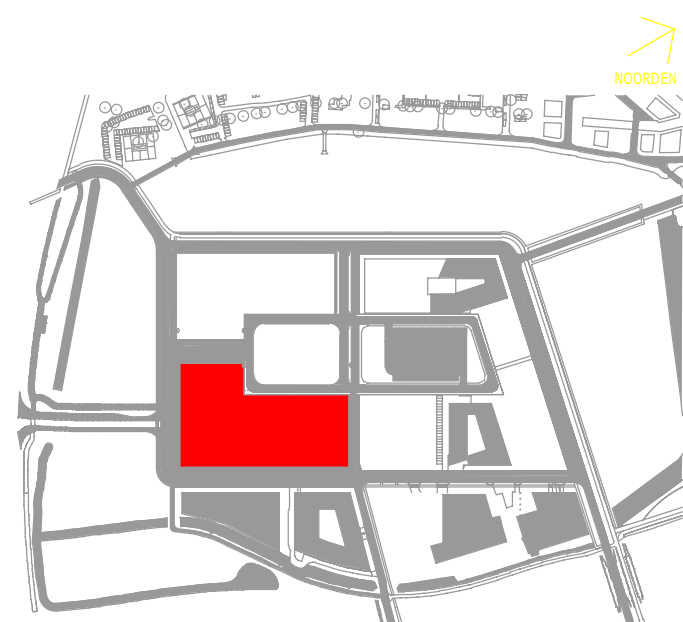
APPROVED BY:

DRAFTER: KC

PROJECT MANAGER: RK

ENGINEERING MANAGER:

QUALITY ASSURANCE:



1	25/05/2021	LAYOUT FREEZE	MB
REV.	DATE	DESCRIPTION	BY



TITLE: MEZZANINE FLOOR

PROJECT: EU CELL THERAPY FACILITY

PHASE:

LOCATION: LEIDEN BIO SCIENCE PARK
NETHERLANDS

CARP: SHEET:

DATE: 25/05/2021

SCALE: 1:200 DRAWING #: 10-005

DESIGNER: KC

VENDOR NAME:

AUTHOR: KC

DISCIPLINE: A

SYSTEM:

EQUIPMENT:

CSI CATEGORY:

OBJECT NAME:

DOCUMENT TYPE:

DEPARTMENT:

occupancy to be determined by BMS

Rapportage ontruimingsberekening conform MR 2012

Project : 6791 Laboratorium Triton

Variant :

Omschrijving

Status berekeningen:

=Complete berekening van het model uitgevoerd (31 scenarios)

Gehele model voldoet aan de eisen aan opvang- en doorstroomcapaciteit in de in de toegepaste rekenmethode

Bestand: 6791 def.Laboratorium Triton 4, aanpas.3-

Bestandsdatum: 2021-06-08 11:14:34

MODELGEGEVENS:

Aantal aanwezigen: 304

Aantal gebieden: 30

Aantal uitgangen: 7

Aantal trappenhuizen: 5

GEBIEDEN

Naam	Nivo[m]	Opvangcap.[m2]	Personen[-]	Bijeenkomstfunctie	Beschermde VR	Ontruimzone	Vultijd	Hellend
1e verd.A	7,2	50,0	0	NEE	NEE	0	60	NEE
1e verd.B	7,2	50,0	0	NEE	NEE	0	60	NEE
1e verd.C werkp	7,2	0,0	20	NEE	NEE	0	60	NEE
1e verd.D	7,2	0,0	4	NEE	NEE	0	60	NEE
1e verd.E	7,2	50,0	75	NEE	NEE	0	60	NEE
1e verd.F	7,2	52,0	33	NEE	NEE	0	60	NEE
1e verd.G	7,2	32,0	0	NEE	NEE	0	60	NEE
Begane grond A	1,1	0,0	7	NEE	NEE	0	60	NEE
Begane grond B	1,1	0,0	7	NEE	NEE	0	60	NEE
Begane grond C	1,1	0,0	7	NEE	NEE	0	60	NEE
Begane grond E	1,1	0,0	9	NEE	NEE	0	60	NEE
Begane grond F1	1,1	0,0	3	NEE	NEE	0	60	NEE
Begane grond F2	1,1	0,0	3	NEE	NEE	0	60	NEE
Begane grond F3	1,1	0,0	9	NEE	NEE	0	60	NEE
Begane grond G	1,1	0,0	21	NEE	NEE	0	60	NEE
Begane grond H	1,1	0,0	5	NEE	NEE	0	60	NEE
Begane grond I	1,1	0,0	15	NEE	NEE	0	60	NEE
Begane grond J	1,1	30,0	53	NEE	NEE	0	60	NEE
Begane grond L1	1,1	94,0	15	NEE	NEE	0	60	NEE
Begane grond L2	1,1	25,0	12	NEE	NEE	0	60	NEE

GEBIEDEN

Naam	Nivo[m]	Opvangcap.[m2]	Personen[-]	Bijeenkomstfunctie	Beschermde VR	Ontruimzone	Vultijd	Hellend
Begane grond M	1,1	0,0	6	NEE	NEE	0	60	NEE
Gang noord 1e	7,2	25,0	0	NEE	NEE	0	60	NEE
Gang oost bg	1,1	96,0	0	NEE	NEE	0	60	NEE
Gang west1 1e	7,2	118,0	0	NEE	NEE	0	60	NEE
Gang west1 bg	1,1	79,0	0	NEE	NEE	0	60	NEE
Gang west2 1e	7,2	20,0	0	NEE	NEE	0	60	NEE
Gang west2 bg	1,1	27,0	0	NEE	NEE	0	60	NEE
Gang west3 bg	1,1	3,0	0	NEE	NEE	0	60	NEE
Gang1 midden bg	1,1	59,0	0	NEE	NEE	0	60	NEE
Gang2 midden bg	1,1	59,0	0	NEE	NEE	0	60	NEE

TRAPPENHUIZEN

Naam	Nivo[m]	Breedte[m]	Gecorr. breedte[m]	Hoofdbordes[m2]	Tussenbordes[m2]	Aantal treden	Veiligh. VR
Tr.1 oost 1e	7,2	1,4	1,4	3,8	0,0	18	NEE
Tr.1 oost bg	1,1	1,4	1,4	7,6	0,0	5	NEE
Tr.1 oost dak	14,4	1,4	1,4	1,9	0,0	18	NEE
Tr.1 oost mezza	3,6	1,4	1,4	3,8	0,0	18	NEE
Tr.1 oost tusse	10,8	1,4	1,4	3,8	0,0	18	NEE
Tr.1 west 1e	7,2	1,4	1,4	3,8	0,0	18	NEE
Tr.1 west bg	1,1	1,4	1,4	7,6	0,0	5	NEE
Tr.1 west dak	14,4	1,4	1,4	1,9	0,0	18	NEE
Tr.1 west mezza	3,6	1,4	1,4	3,8	0,0	18	NEE
Tr.1 west tusse	10,8	1,4	1,4	3,8	0,0	18	NEE
Tr.2 oost 1e	7,2	1,4	1,4	3,8	0,0	18	NEE
Tr.2 oost bg	1,1	1,4	1,4	7,6	0,0	5	NEE
Tr.2 oost dak	14,4	1,4	1,4	1,9	0,0	18	NEE
Tr.2 oost mezza	3,6	1,4	1,4	3,8	0,0	18	NEE
Tr.2 oost tusse	10,8	1,4	1,4	3,8	0,0	18	NEE
Tr.2 west 1e	7,2	1,4	1,4	3,8	0,0	18	NEE
Tr.2 west bg	1,1	1,4	1,4	7,6	0,0	5	NEE
Tr.2 west dak	14,4	1,4	1,4	1,9	0,0	18	NEE
Tr.2 west mezza	3,6	1,4	1,4	3,8	0,0	18	NEE
Tr.2 west tusse	10,8	1,4	1,4	3,8	0,0	18	NEE

TRAPPENHUIZEN

Naam	Nivo[m]	Breedte[m]	Gecorr. breedte[m]	Hoofdbordes[m2]	Tussenbordes[m2]	Aantal treden	Veiligh. VR
Tr.noord 1e	7,2	1,4	1,4	1,9	0,0	18	NEE
Tr.noord bg	1,1	1,4	1,4	7,6	0,0	5	NEE
Tr.noord mezzan	3,6	1,4	1,4	3,8	0,0	18	NEE

VERBINDINGEN

Naam	Van	Naar	Bxx	Type heen	Breed	Type terug	Breed
v103	Begane grond I	Begane grond J	B20	enkele deur (< 135°)	0,85	deur tegen vluchtri.(nieuw)	0,0
v104	Begane grond J	Begane grond I	B20	enkele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	0,85
v105	Begane grond J	Tr.2 west bg	B60	enkele deur (< 135°)	0,85	deur tegen vluchtri.(nieuw)	0,85
v106	Begane grond J	buiten	geen	enkele deur (< 135°)	0,85		
v108	Gang2 midden bg	Begane grond J	B20	enkele deur (< 135°)	0,85	deur tegen vluchtri.(nieuw)	0,0
v109	Begane grond J	Tr.2 oost bg	B60	enkele deur (< 135°)	0,85	deur tegen vluchtri.(nieuw)	0,85
v110	Begane grond L2	Begane grond L1	geen	vide (open verbinding)	0,0	vide (open verbinding)	0,0
v113	Gang2 midden bg	Gang1 midden bg	B20	dubbele deur (< 135°)	1,7	deur tegen vluchtri.(nieuw)	1,7
v114	Gang1 midden bg	Begane grond L1	B20	dubbele deur (< 135°)	1,7	deur tegen vluchtri.(nieuw)	1,7
v115	Gang2 midden bg	Begane grond F3	B20	dubbele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	1,7
v116	Begane grond L1	Begane grond M	B60	dubbele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	1,7
v117	Begane grond L1	Tr.1 oost bg	B60	enkele deur (< 135°)	0,85	deur tegen vluchtri.(nieuw)	0,85
v118	Begane grond L2	Begane grond M	B60	dubbele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	1,7
v119	Begane grond L2	Tr.1 west bg	B60	enkele deur (< 135°)	0,85	deur tegen vluchtri.(nieuw)	0,85
v121	Gang west1 bg	Begane grond F3	B20	dubbele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	1,7
v122	Begane grond I	Gang west2 bg	B20	enkele deur (< 135°)	0,85	deur tegen vluchtri.(nieuw)	0,0
v124	Gang west2 bg	Gang west3 bg	B20	enkele deur (< 135°)	0,85	deur tegen vluchtri.(nieuw)	0,85
v125	Gang west3 bg	buiten	geen	doorgang (45 p/m.min)	1,0		
v126	Gang1 midden bg	Begane grond F1	B20	enkele deur (< 135°)	0,0	enkele deur (< 135°)	0,85
v127	Gang noord 1e	1e verd.A	B20	dubbele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	1,7

VERBINDINGEN

Naam	Van	Naar	Bxx	Type heen	Breed	Type terug	Breed
v13	Tr.1 oost tusse	Tr.1 oost 1e	geen	trap (aantrede > 0.17m)	1,4	trap (aantrede > 0.17m)	1,4
v14	Tr.1 west tusse	Tr.1 west 1e	geen	trap (aantrede > 0.17m)	1,4	trap (aantrede > 0.17m)	1,4
v16	Gang west1 1e	Tr.1 west 1e	B60	enkele deur (< 135°)	0,85	deur tegen vluchtri.(nieuw)	0,85
v17	1e verd.C werkp	1e verd.A	B20	dubbele deur (< 135°)	1,7	deur tegen vluchtri.(nieuw)	0,0
v18	1e verd.B	Gang noord 1e	B60	dubbele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	1,7
v19	Gang noord 1e	Tr.noord 1e	B60	enkele deur (< 135°)	0,85	deur tegen vluchtri.(nieuw)	0,85
v20	1e verd.B	Tr.1 oost 1e	B60	enkele deur (< 135°)	0,85	deur tegen vluchtri.(nieuw)	0,85
v30	Gang west2 1e	Gang west1 1e	B20	enkele deur (< 135°)	0,85	deur tegen vluchtri.(nieuw)	0,0
v33	1e verd.F	Gang west1 1e	B20	dubbele deur (< 135°)	1,7	deur tegen vluchtri.(nieuw)	0,0
v34	1e verd.E	1e verd.F	B20	dubbele deur (< 135°)	1,7	deur tegen vluchtri.(nieuw)	1,7
v35	1e verd.E	1e verd.F	B20	dubbele deur (< 135°)	1,7	deur tegen vluchtri.(nieuw)	1,7
v37	Tr.2 oost tusse	Tr.2 oost 1e	geen	trap (aantrede > 0.17m)	1,4	trap (aantrede > 0.17m)	1,4
v38	Tr.2 west tusse	Tr.2 west 1e	geen	trap (aantrede > 0.17m)	1,4	trap (aantrede > 0.17m)	1,4
v39	1e verd.E	Tr.2 west 1e	B60	enkele deur (< 135°)	0,85	deur tegen vluchtri.(nieuw)	0,85
v4	Tr.1 oost dak	Tr.1 oost tusse	geen	trap (aantrede > 0.17m)	1,4	trap (aantrede > 0.17m)	1,4
v40	1e verd.F	Tr.2 oost 1e	B60	enkele deur (< 135°)	0,85	deur tegen vluchtri.(nieuw)	0,85
v41	Tr.1 oost 1e	Tr.1 oost mezza	geen	trap (aantrede > 0.17m)	1,4	trap (aantrede > 0.17m)	1,4
v42	Tr.1 west 1e	Tr.1 west mezza	geen	trap (aantrede > 0.17m)	1,4	trap (aantrede > 0.17m)	1,4
v5	Tr.1 west dak	Tr.1 west tusse	geen	trap (aantrede > 0.17m)	1,4	trap (aantrede > 0.17m)	1,4
v55	Tr.noord 1e	Tr.noord mezzan	geen	trap (aantrede > 0.17m)	1,4	trap (aantrede > 0.17m)	1,4

VERBINDINGEN

Naam	Van	Naar	Bxx	Type heen	Breed	Type terug	Breed
v58	Tr.2 oost 1e	Tr.2 oost mezza	geen	trap (aantrede > 0.17m)	1,4	trap (aantrede > 0.17m)	1,4
v59	Tr.2 west 1e	Tr.2 west mezza	geen	trap (aantrede > 0.17m)	1,4	trap (aantrede > 0.17m)	1,4
v6	Tr.2 oost dak	Tr.2 oost tusse	geen	trap (aantrede > 0.17m)	1,4	trap (aantrede > 0.17m)	1,4
v60	Tr.1 oost mezza	Tr.1 oost bg	geen	trap (aantrede > 0.17m)	1,4	trap (aantrede > 0.17m)	1,4
v61	Tr.noord mezzan	Tr.noord bg	geen	trap (aantrede > 0.17m)	1,4	trap (aantrede > 0.17m)	1,4
v64	1e verd.F	Begane grond J	geen	vide (open verbinding)	1,0	vide (open verbinding)	1,0
v65	Tr.2 oost mezza	Tr.2 oost bg	geen	trap (aantrede > 0.17m)	1,4	trap (aantrede > 0.17m)	1,4
v66	Tr.2 west mezza	Tr.2 west bg	geen	trap (aantrede > 0.17m)	1,4	trap (aantrede > 0.17m)	1,4
v67	Tr.1 west mezza	Tr.1 west bg	geen	trap (aantrede > 0.17m)	1,4	trap (aantrede > 0.17m)	1,4
v68	Tr.1 oost bg	buiten	geen	doorgang (45 p/m.min)	1,0		
v69	Tr.2 oost bg	buiten	geen	doorgang (45 p/m.min)	1,0		
v7	Tr.2 west dak	Tr.2 west tusse	geen	trap (aantrede > 0.17m)	1,4	trap (aantrede > 0.17m)	1,4
v70	Tr.1 west bg	buiten	geen	doorgang (45 p/m.min)	1,0		
v71	Tr.2 west bg	buiten	geen	doorgang (45 p/m.min)	1,0		
v73	Begane grond L1	Begane grond A	B20	enkele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	0,85
v74	Gang1 midden bg	Begane grond A	B20	enkele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	0,85
v75	Begane grond L1	Begane grond B	B20	enkele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	0,85
v76	Gang1 midden bg	Begane grond B	B20	enkele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	0,85
v77	Begane grond L1	Begane grond C	B20	enkele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	0,85
v78	Gang2 midden bg	Begane grond C	B20	enkele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	0,85

VERBINDINGEN

Naam	Van	Naar	Bxx	Type heen	Breed	Type terug	Breed
v79	Tr.noord bg	buiten	geen	doorgang (45 p/m.min)	1,0		
v80	1e verd.G	1e verd.B	B120	dubbele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	1,7
v81	1e verd.F	1e verd.G	B20	dubbele deur (< 135°)	1,7	deur tegen vluchtri.(nieuw)	1,7
v82	Gang west1 1e	1e verd.G	B20	dubbele deur (< 135°)	1,7	deur tegen vluchtri.(nieuw)	1,7
v83	Gang west1 1e	1e verd.C werkp	B60	dubbele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	1,7
v84	Gang west2 1e	1e verd.E	B20	enkele deur (ohoek < 135°)	0,85	deur tegen vluchtri.(nieuw)	0,85
v85	Begane grond J	Gang west2 bg	B20	enkele deur (< 135°)	0,85	deur tegen vluchtri.(nieuw)	0,85
v86	1e verd.D	1e verd.F	B20	enkele deur (ohoek < 135°)	0,85	deur tegen vluchtri.(nieuw)	0,0
v87	1e verd.D	Gang west2 1e	B20	enkele deur (ohoek < 135°)	0,85	deur tegen vluchtri.(nieuw)	0,0
v88	Gang1 midden bg	Begane grond E	B20	enkele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	0,85
v89	Begane grond L2	Begane grond E	B20	enkele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	0,85
v91	Gang2 midden bg	Begane grond F2	B20	enkele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	0,85
v92	Gang2 midden bg	Begane grond G	B20	enkele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	0,85
v93	Gang west1 bg	Begane grond G	B20	enkele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	0,85
v94	Begane grond L1	Gang oost bg	B20	dubbele deur (< 135°)	1,7	deur tegen vluchtri.(nieuw)	1,7
v96	Gang2 midden bg	Gang oost bg	B20	dubbele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	1,7
v97	Gang west1 bg	Gang2 midden bg	B20	dubbele deur (< 135°)	1,7	deur tegen vluchtri.(nieuw)	1,7
v98	Begane grond L2	Gang west1 bg	B20	dubbele deur (< 135°)	1,7	deur tegen vluchtri.(nieuw)	1,7
v99	Gang west1 bg	Begane grond H	B20	enkele deur (< 135°)	0,0	deur tegen vluchtri.(nieuw)	0,85

TOELICHTING FIGUUR BIJLAGE: Visualiseren van het verloop van de ontruiming

Voor elk geselecteerde scenario is een aparte bladzijde aanwezig met het gehele rekenmodel.

De figuur is opgebouwd uit lagen waarin de gegevens van een berekening/model geplot zijn.

- de eerste 2 lagen kunnen evt. plattegronden en teksten bevatten (ondergrond) die aan/uitgezet kunnen worden
- verdere lagen geven per laag voor de betreffende tijdstap aan hoeveel personen nog in de gebieden aanwezig zijn, en hoeveel personen in die tijdstap door alle verbindingen zijn gepasseerd
- de laatste figuurbladzijde bevat extra gegevens van gebieden/verbindingen [deurbreedte, aantal treden etc] als kleine driehoekjes bij objecten, die openvouwen na aanwijzen met de muis
- op één bladzijde zijn alle verbindingen aangegeven waardoor in enig scenario meer dan 100 personen passeren [hulpmiddel paniekbetog]

Middels het menu "lagen" in Acrobat Reader, kunnen de verschillende tijdstappen worden zichtbaar gemaakt, door de betreffende laag te activeren.

Het menu "lagen" kan in Acrobat Reader worden geactiveerd via het menu: Beeld | Tonen,verbergen | navigatievensters | lagen

Er verschijnt dan een formulier aan de zijkant van het scherm met alle lagen, die aan en uitgezet kunnen worden.

Het handigst werkt het om eerst in te zoomen op het gewenste gebied in de pdf, en daarna met de muis de eerste tijdstap in het lagenformulier te selecteren

--Vervolgens kan met de spatiebalk de geselecteerde laag worden (de-)geactiveerd.

--Met de cursorijsen op het toetsenbord kunnen andere lagen worden geselecteerd die met een druk op de spatiebalk worden geactiveerd

De resultaten van elke tijdstap (dus de personen aantallen) worden in de plattegrond over de vorige tijdstap heengetekend,

zodat de hele berekening voor het betreffende scenario kan worden beoordeeld, door de opeenvolgende tijdstappen (lagen) te activeren.

--In de plattegronden zijn voor elk scenario met brand, de gebieden met brand rood gekleurd; de overige gebieden groen en de trappenhuizen blauw gekleurd

--In de gebieden is aangegeven hoeveel personen aan het einde van elke tijdstap nog aanwezig zijn in dat gebied

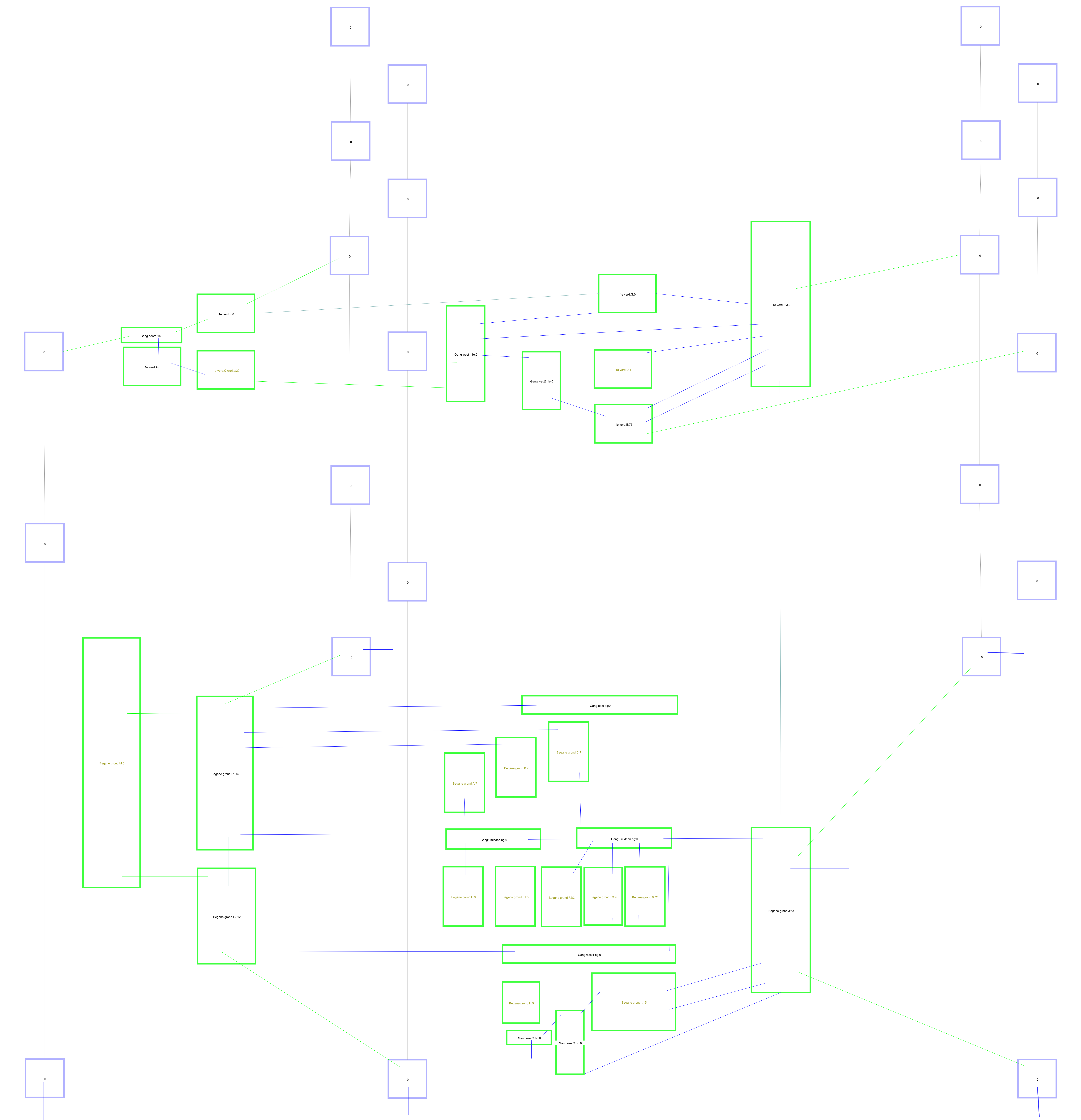
--Bij de verbindingen is tussen rechte haken [xx] aangegeven hoeveel personen in de beschouwde tijdstap de verbinding (deur,uitgang) zijn gepasseerd

--Bij de verbindingen is tussen ronde haken (xx) aangegeven hoeveel personen totaal (t/m de beschouwde tijdstap) de verbinding (deur,uitgang) zijn gepasseerd

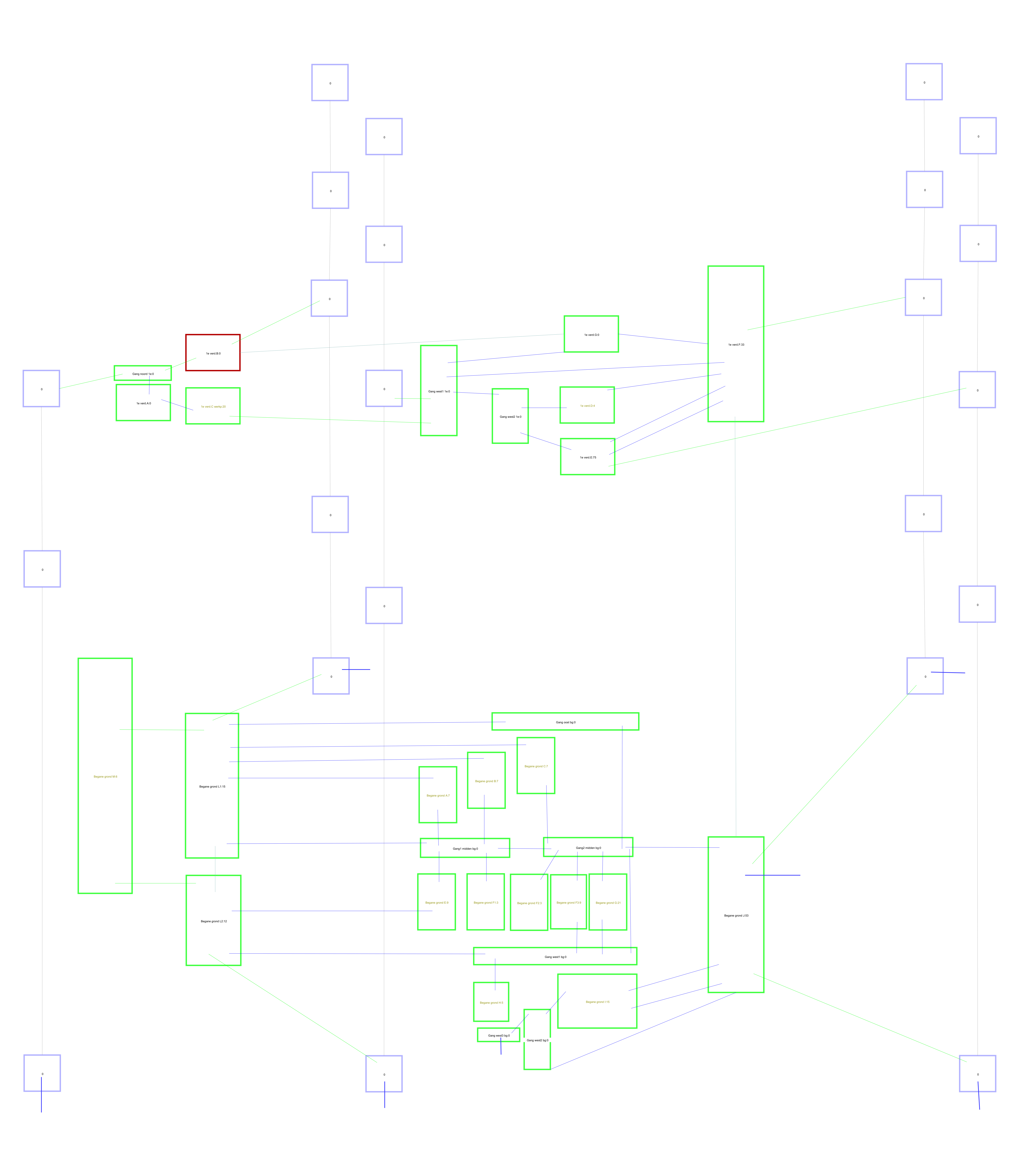
De personen aantallen worden in standaard in het zwart afgedrukt. De aantallen worden echter in beige afgedrukt als:

--- van een gebied in de betreffende tijdstap de gehele opvangcapaciteit benut is, of

--- de capaciteit van een uitgang in de betreffende tijdstap maximaal benut is

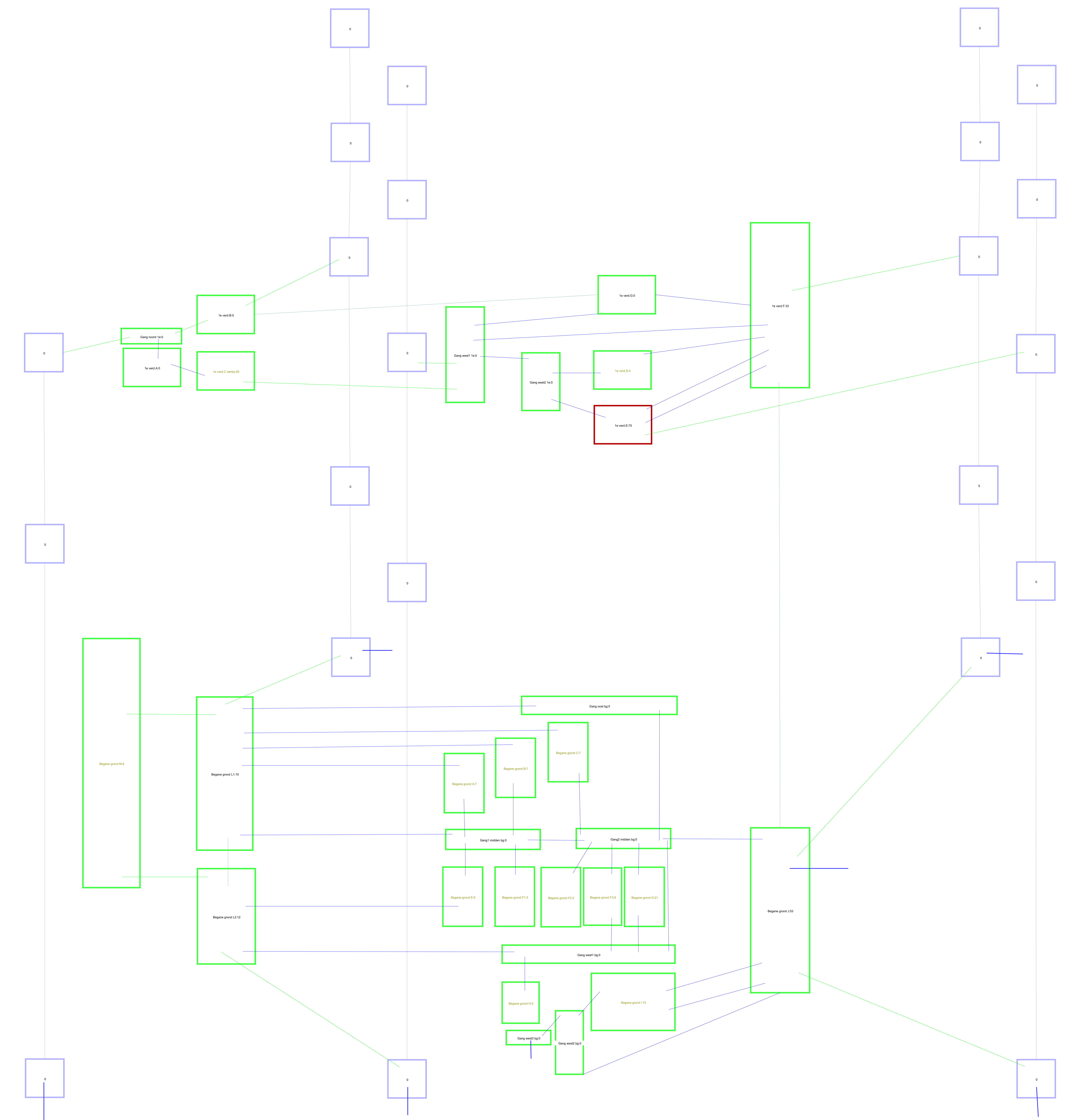


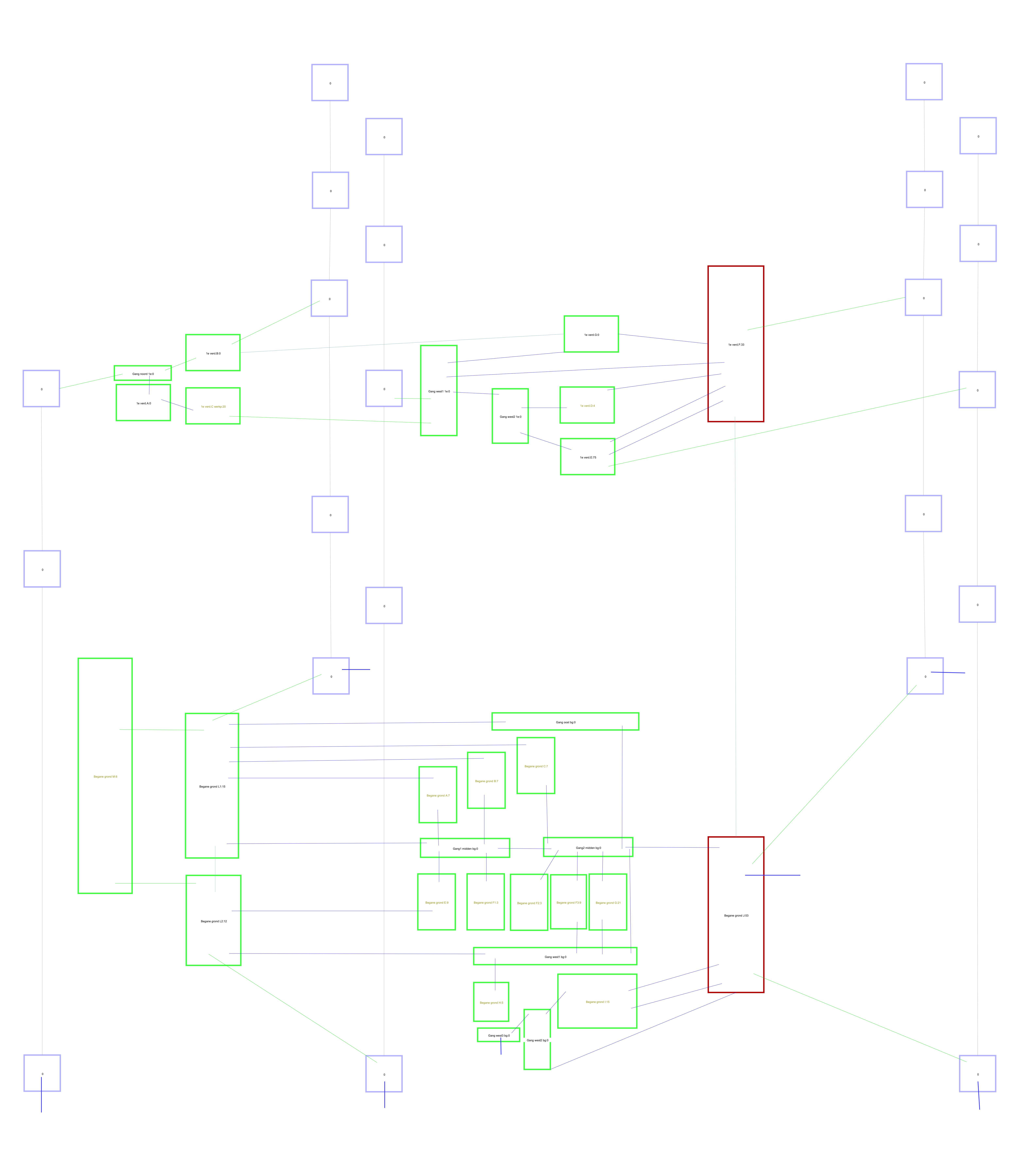


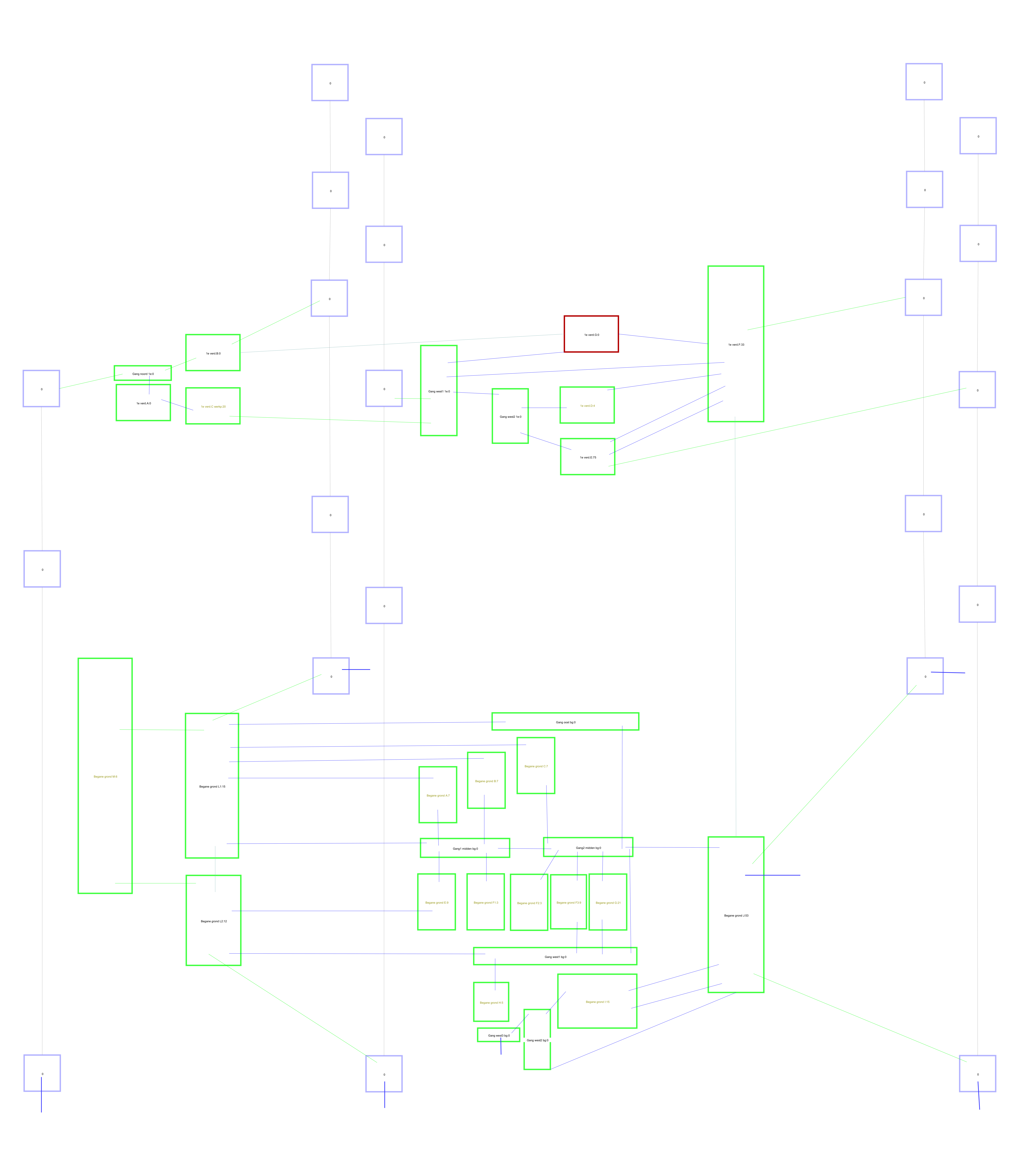




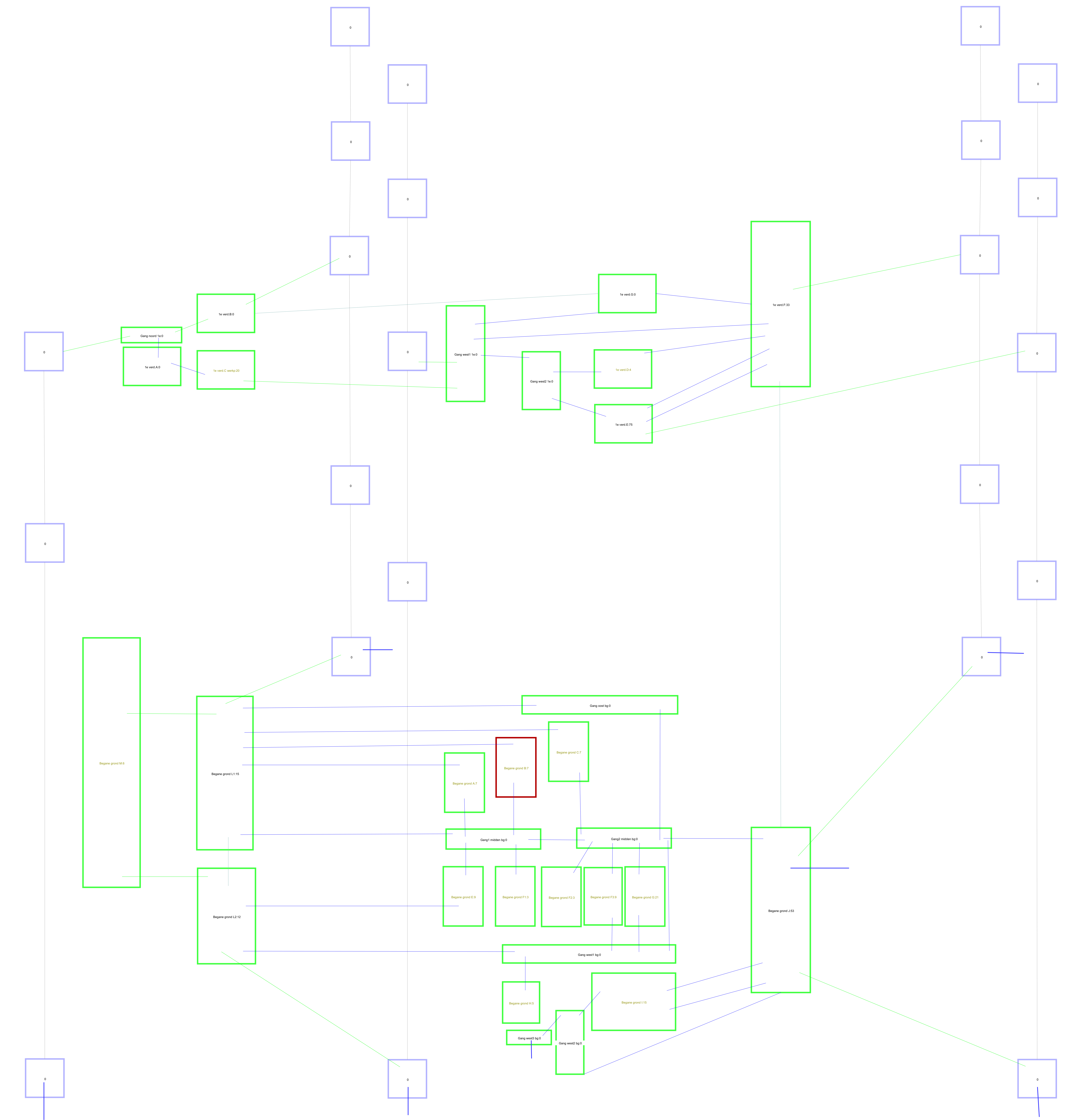




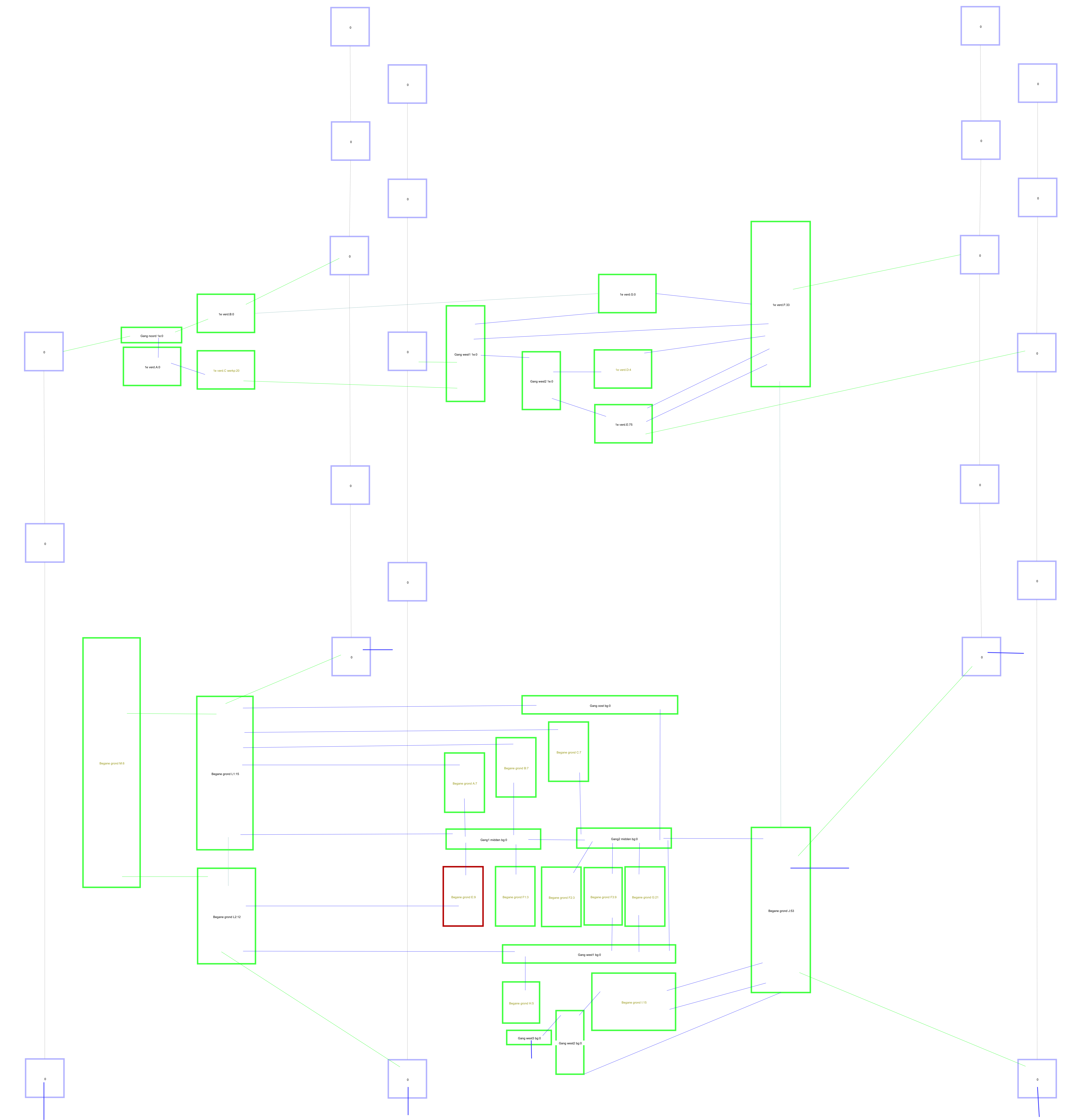










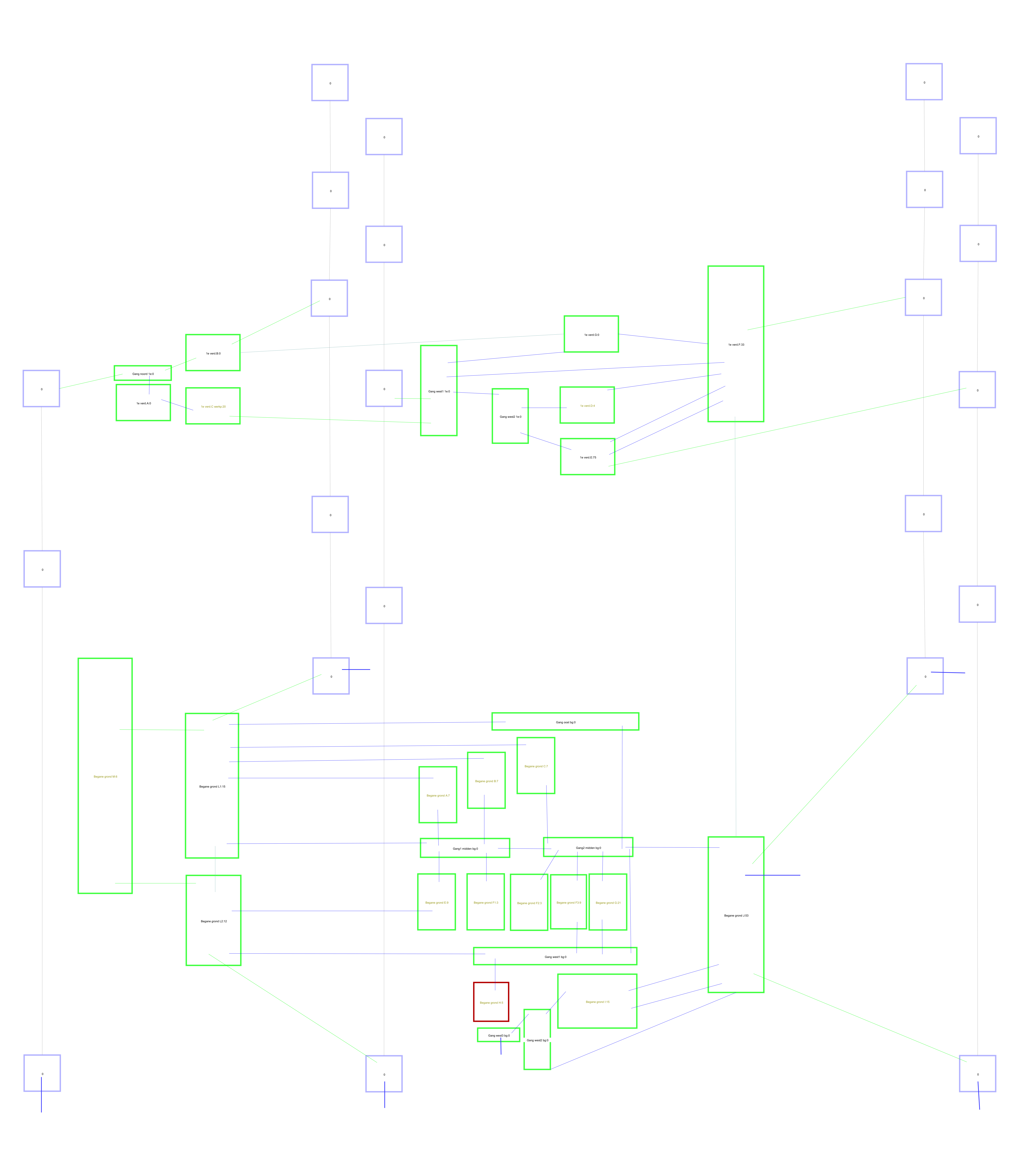






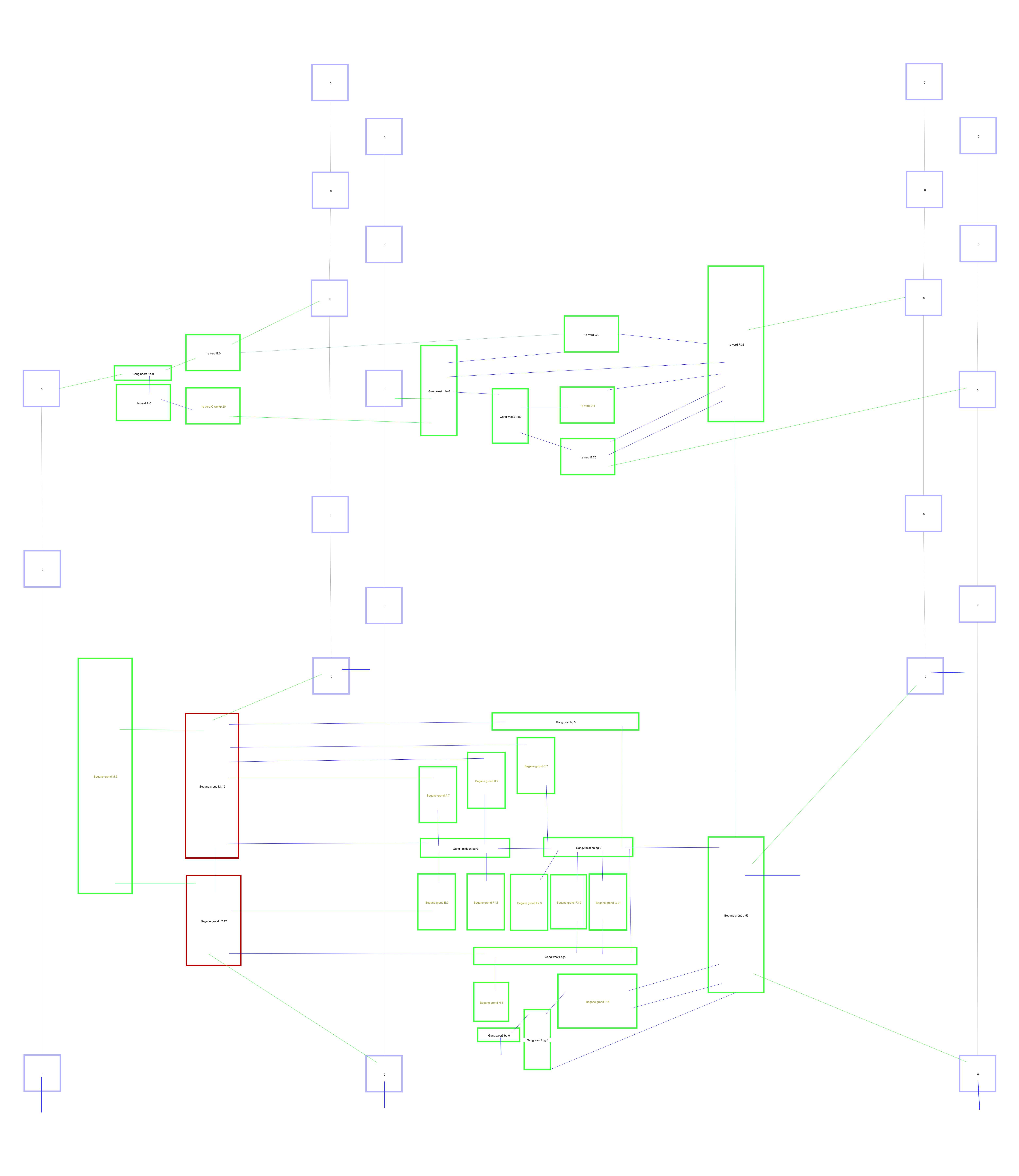




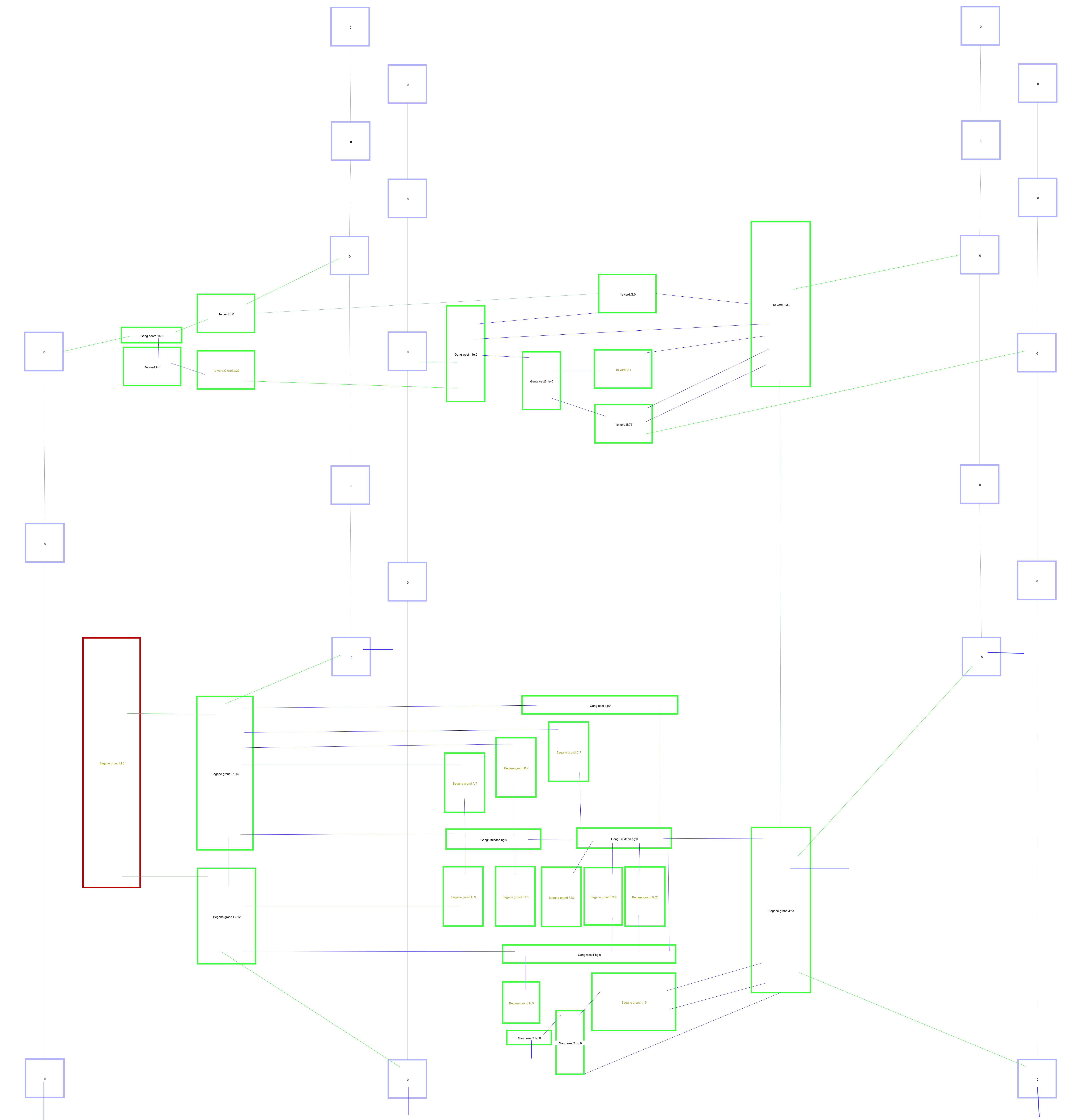




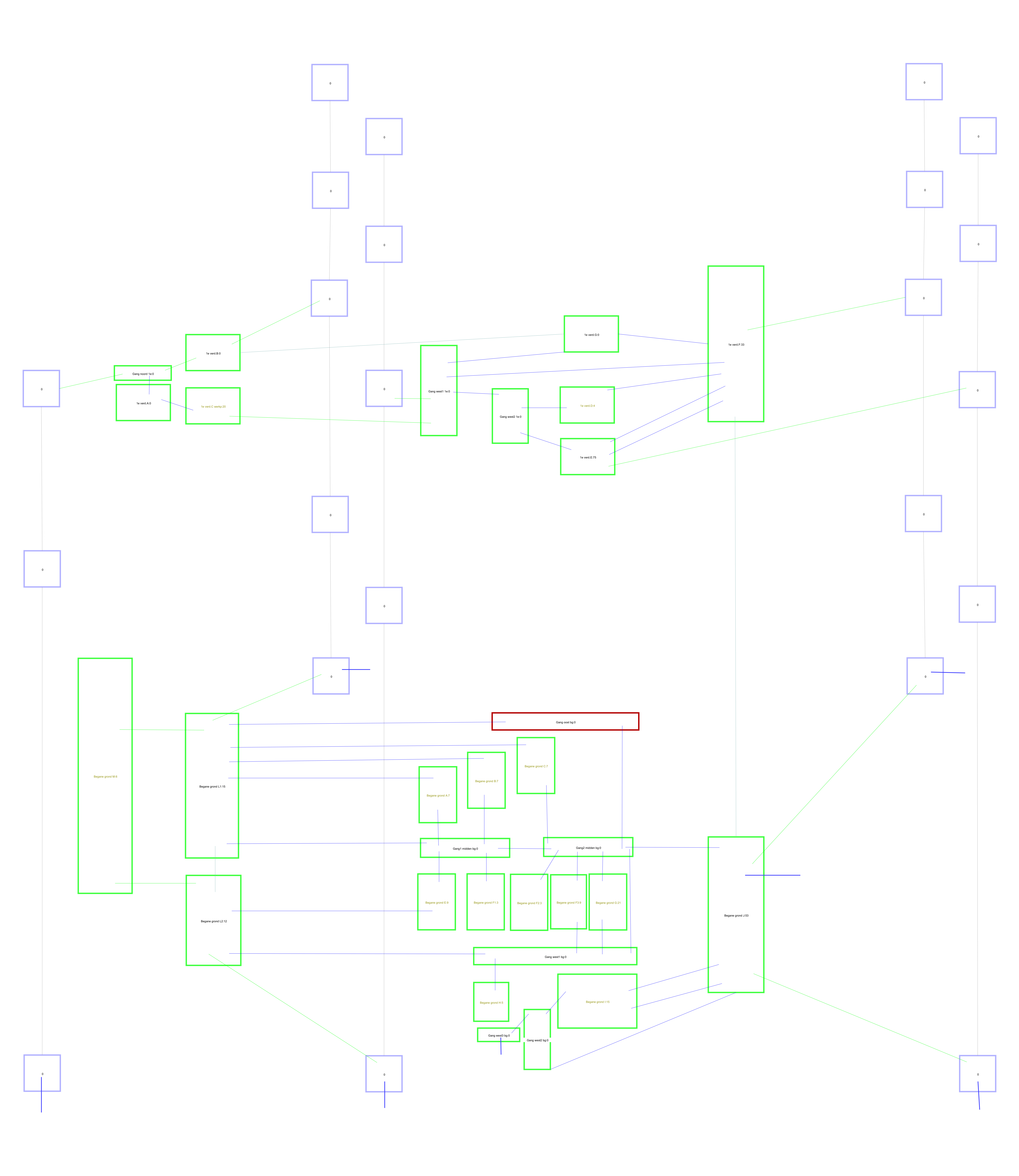


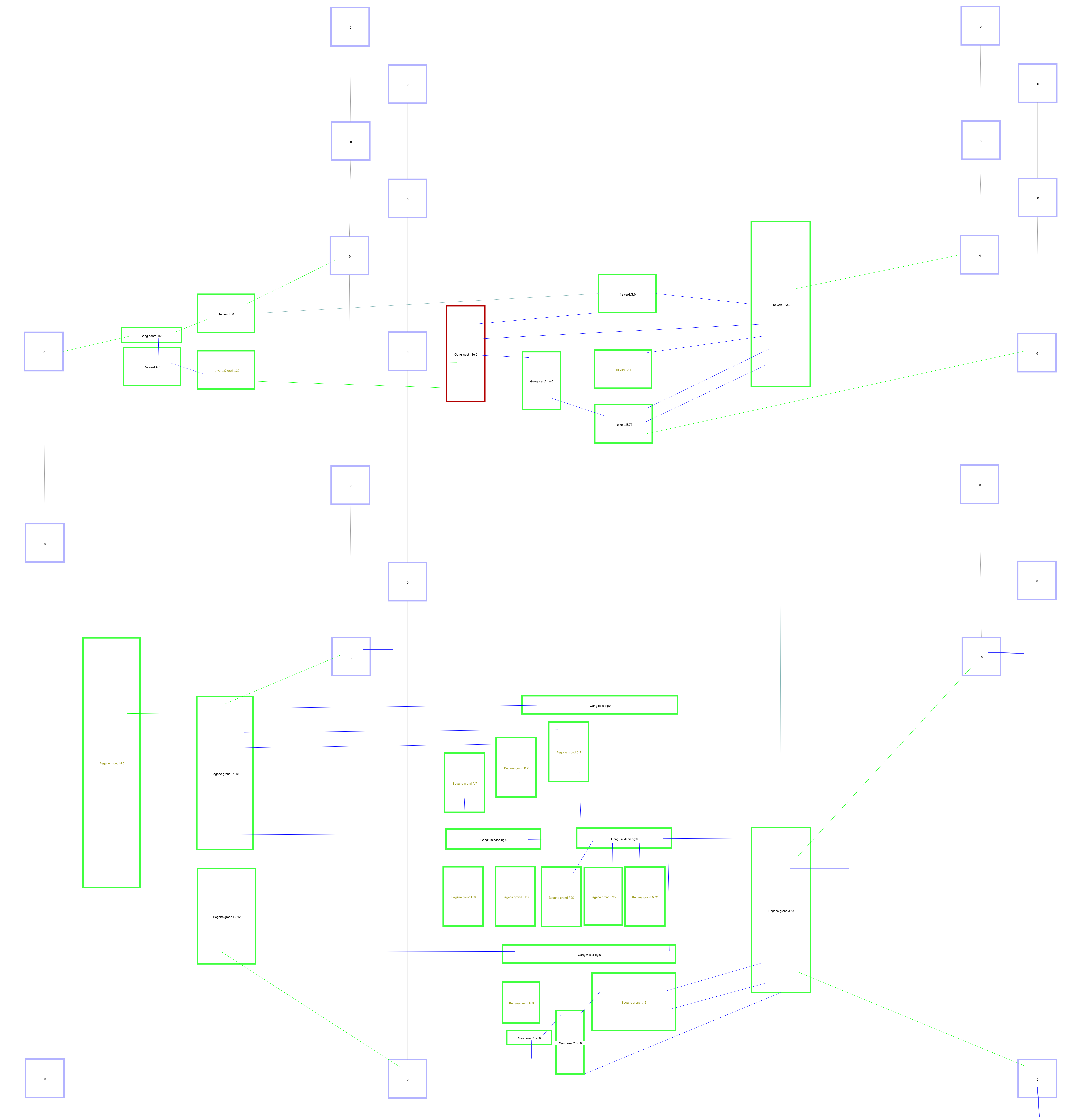


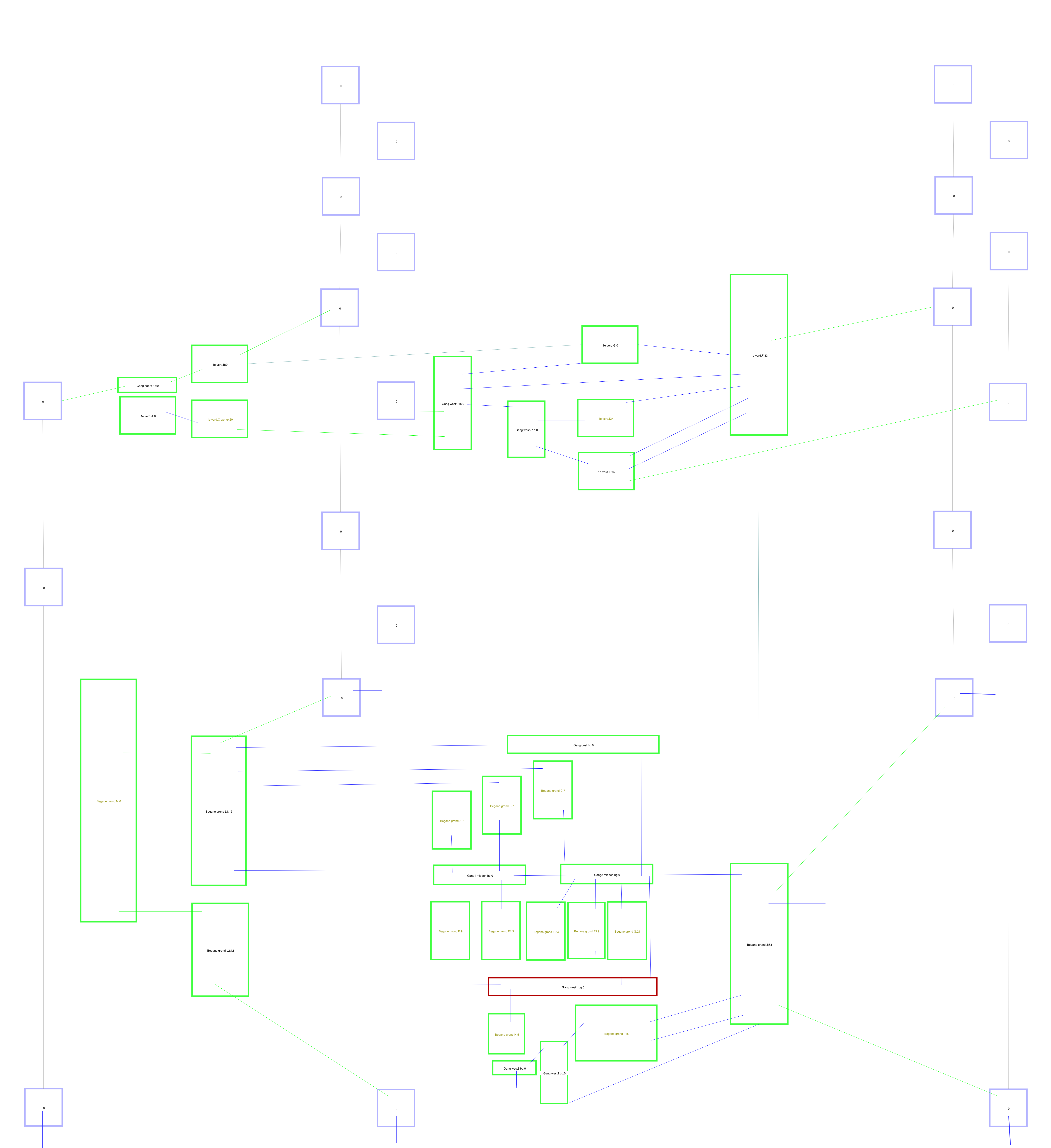


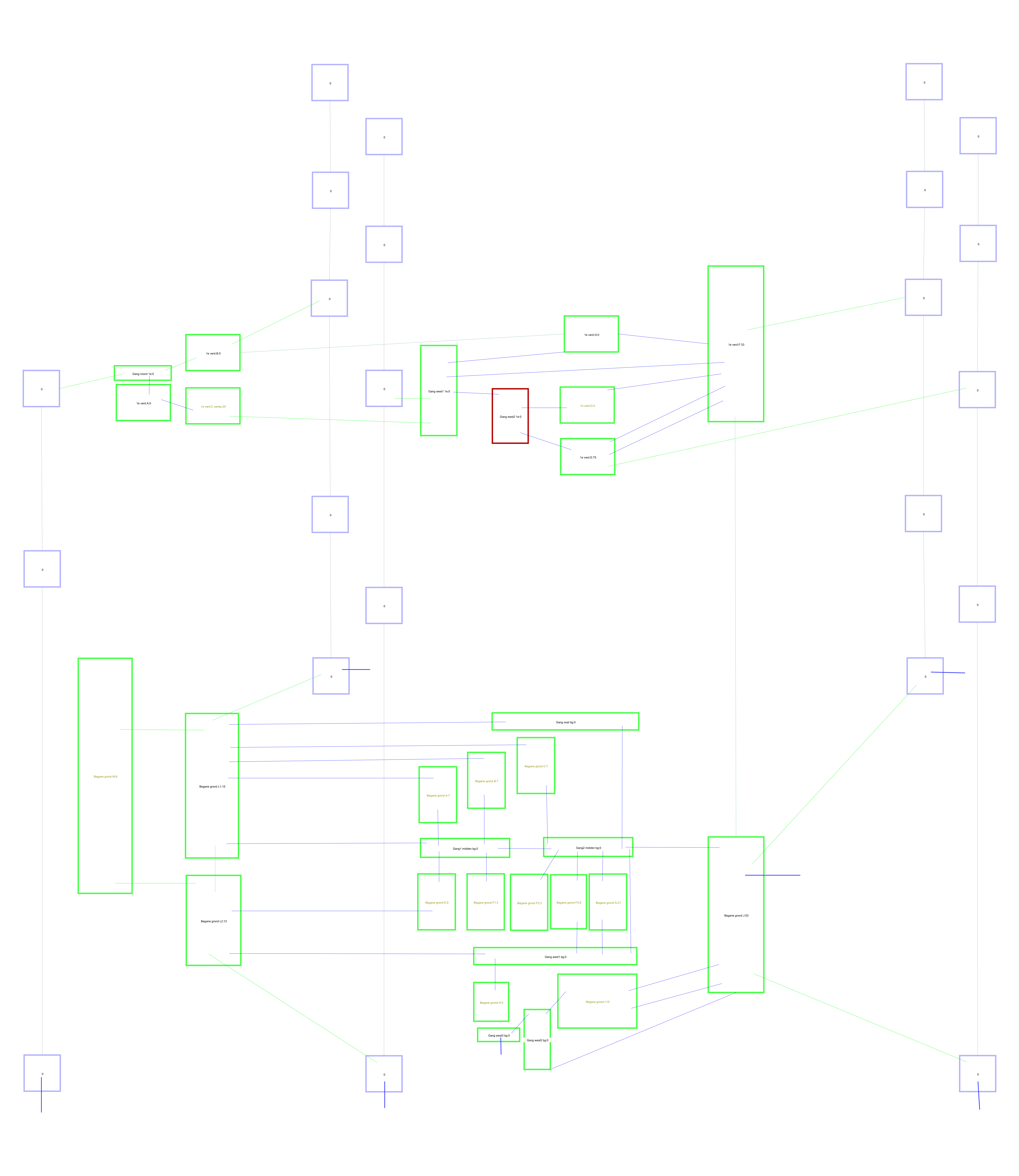


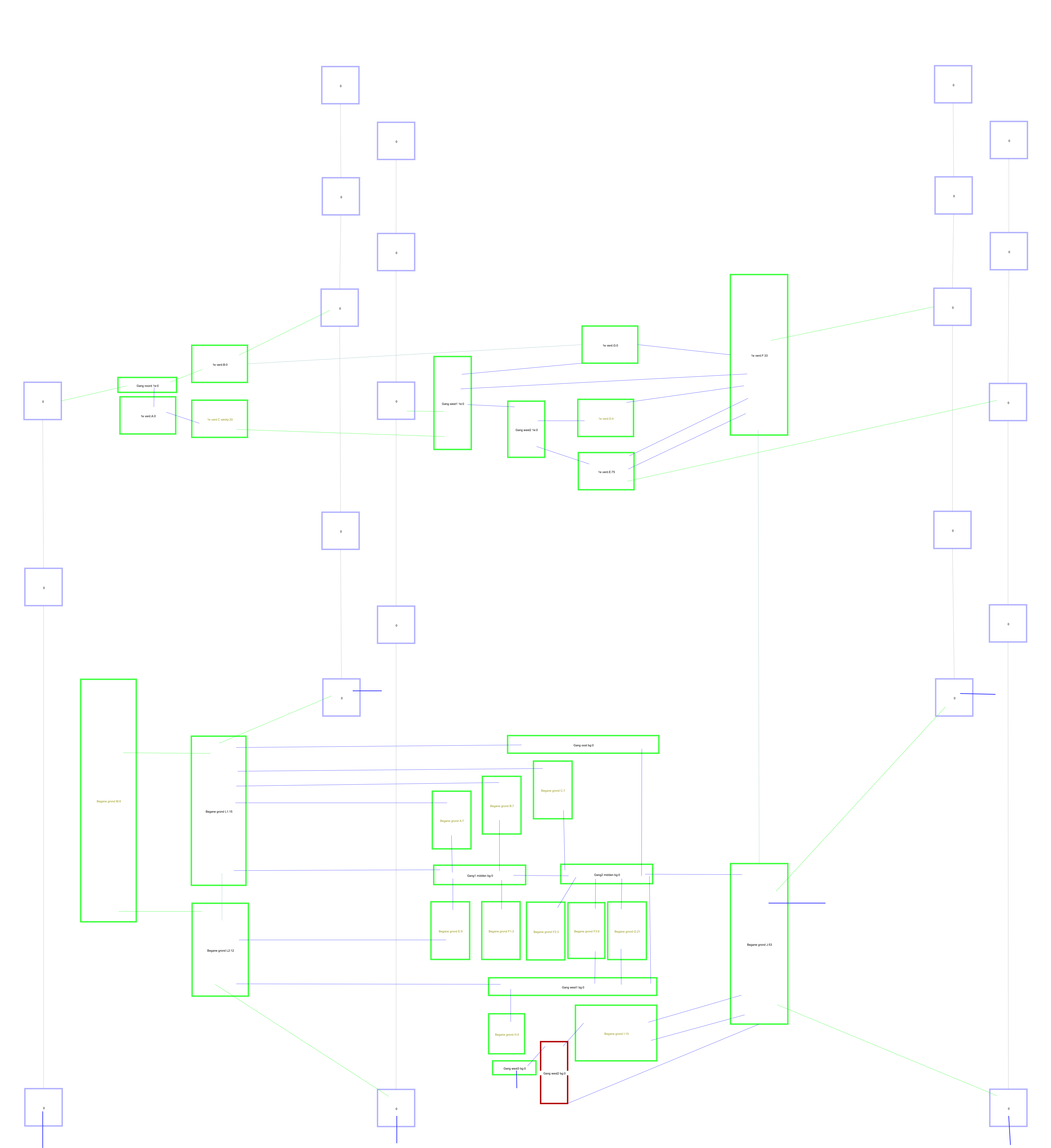


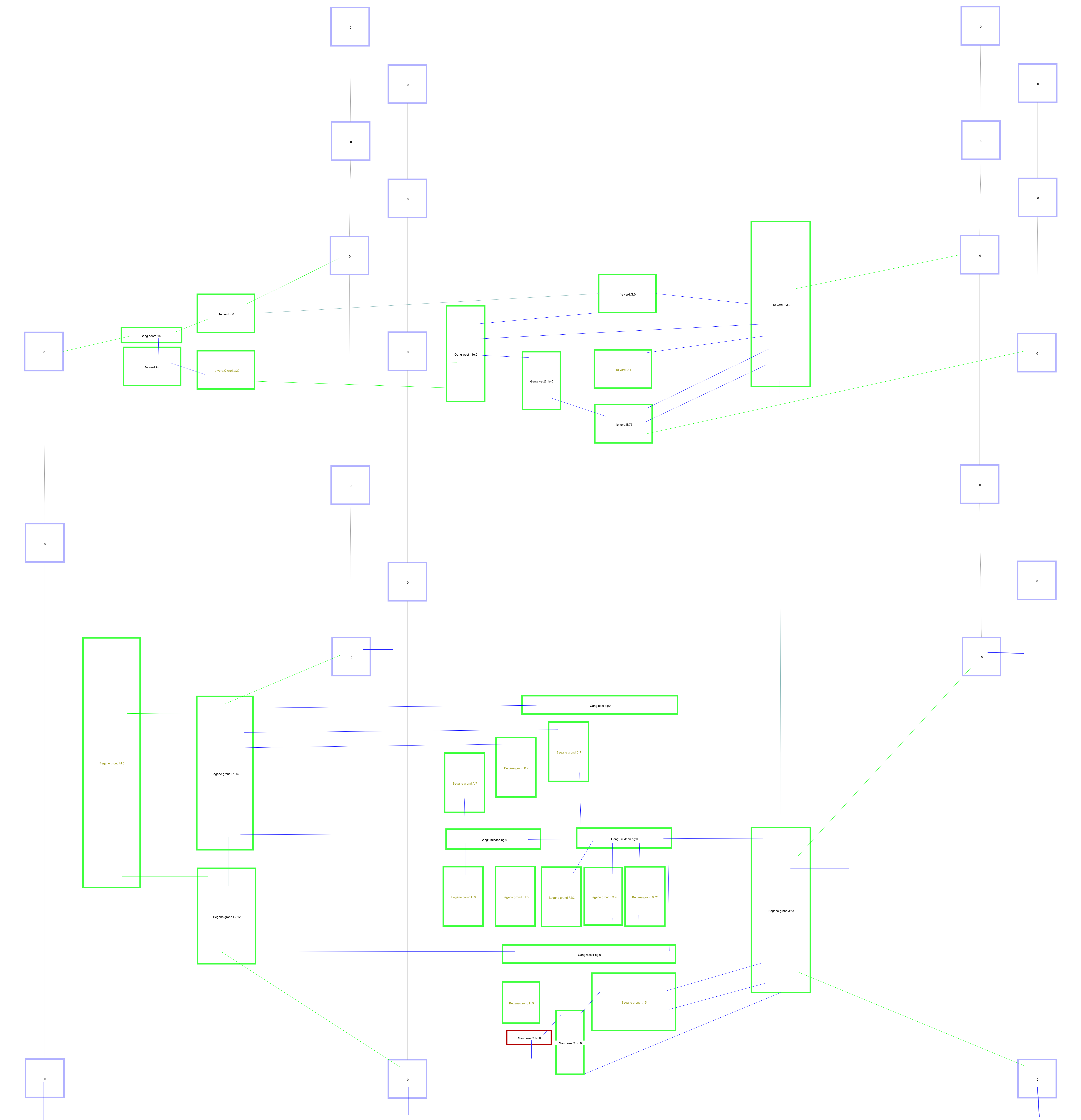




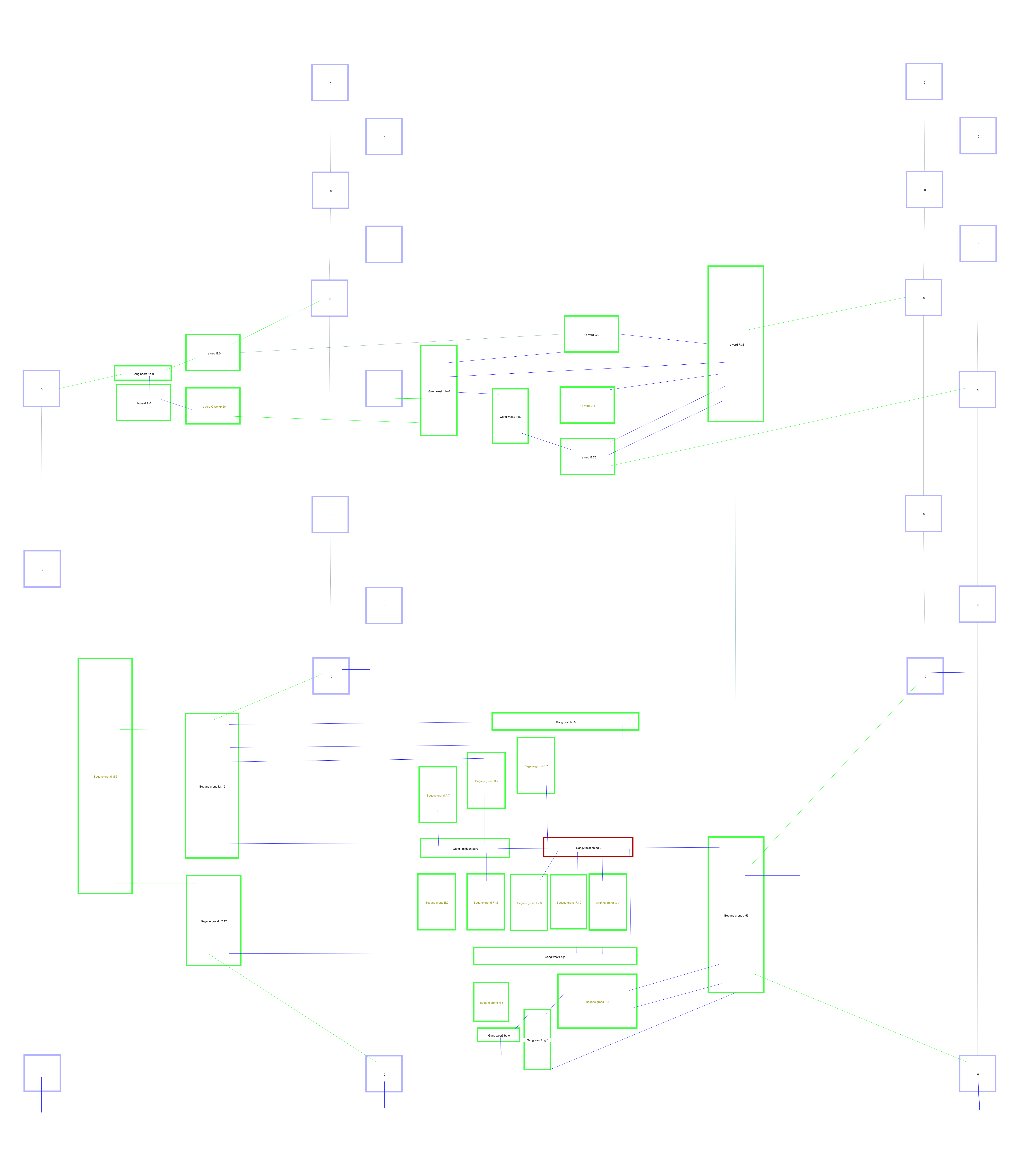




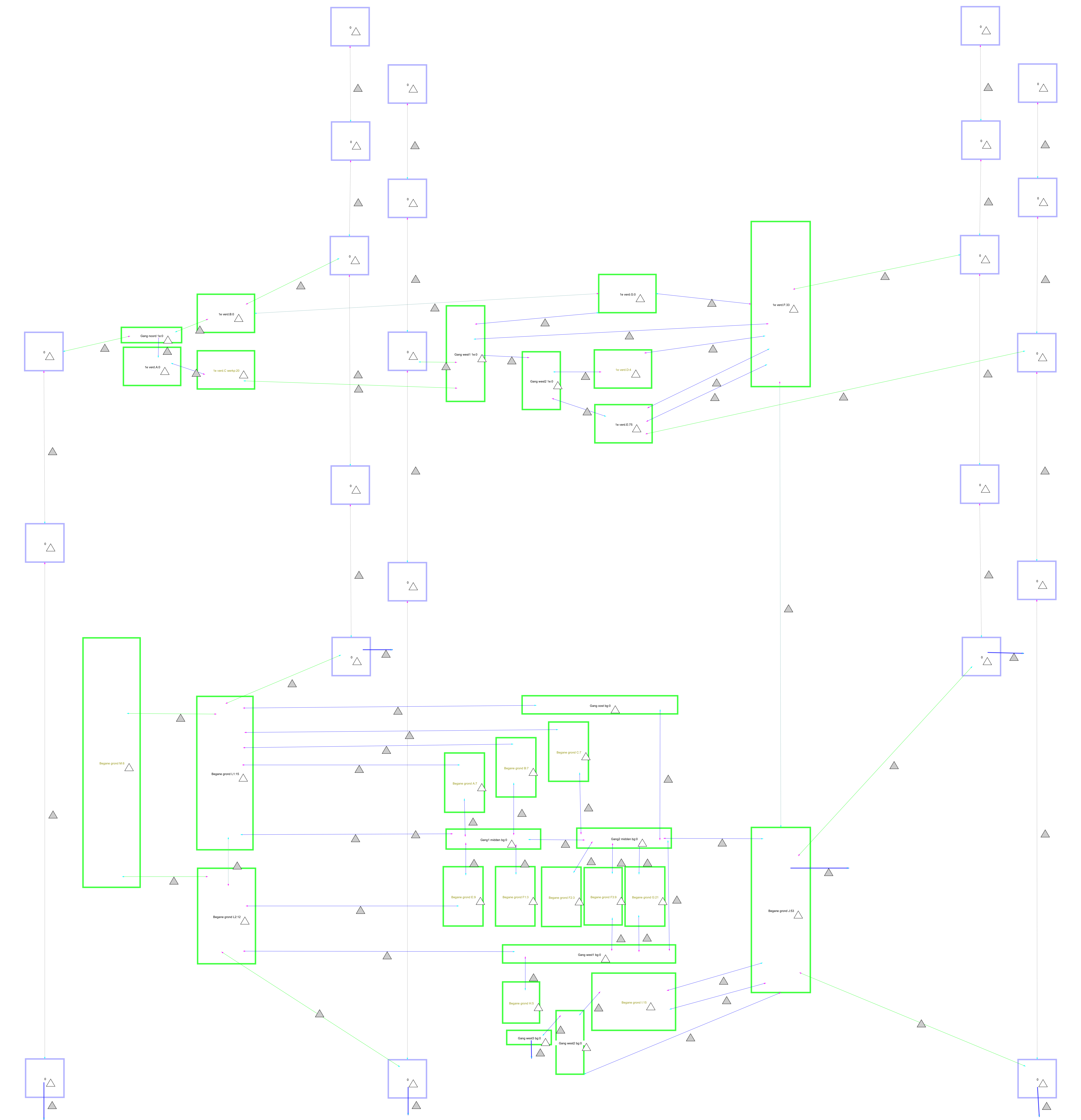












Overzicht personen aantallen per gebied in alle gebieden

SCENARIO: Ontruiming zonder brand

Ontruimingstijd: 2,0 min

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6	15	20	30
1e verd.A		-	-	-	-	-	-	-	-	-	-	-	-
1e verd.B		-	-	-	-	-	-	-	-	-	-	-	-
1e verd.C werkp		20	-	-	-	-	-	-	-	-	-	-	-
1e verd.D		4	-	-	-	-	-	-	-	-	-	-	-
1e verd.E		75	-	-	-	-	-	-	-	-	-	-	-
1e verd.F		33	1	-	-	-	-	-	-	-	-	-	-
1e verd.G		-	-	-	-	-	-	-	-	-	-	-	-
Begane grond A		7	-	-	-	-	-	-	-	-	-	-	-
Begane grond B		7	-	-	-	-	-	-	-	-	-	-	-
Begane grond C		7	-	-	-	-	-	-	-	-	-	-	-
Begane grond E		9	-	-	-	-	-	-	-	-	-	-	-
Begane grond F1		3	-	-	-	-	-	-	-	-	-	-	-
Begane grond F2		3	-	-	-	-	-	-	-	-	-	-	-
Begane grond F3		9	-	-	-	-	-	-	-	-	-	-	-
Begane grond G		21	-	-	-	-	-	-	-	-	-	-	-
Begane grond H		5	-	-	-	-	-	-	-	-	-	-	-
Begane grond I		15	-	-	-	-	-	-	-	-	-	-	-
Begane grond J		53	-	-	-	-	-	-	-	-	-	-	-
Begane grond L1		15	-	-	-	-	-	-	-	-	-	-	-
Begane grond L2		12	-	-	-	-	-	-	-	-	-	-	-
Begane grond M		6	-	-	-	-	-	-	-	-	-	-	-
Gang noord 1e		-	-	-	-	-	-	-	-	-	-	-	-
Gang oost bg		-	-	-	-	-	-	-	-	-	-	-	-
Gang west1 1e		-	2	-	-	-	-	-	-	-	-	-	-
Gang west1 bg		-	-	-	-	-	-	-	-	-	-	-	-
Gang west2 1e		-	-	-	-	-	-	-	-	-	-	-	-
Gang west2 bg		-	-	-	-	-	-	-	-	-	-	-	-
Gang west3 bg		-	-	-	-	-	-	-	-	-	-	-	-
Gang1 midden bg		-	-	-	-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in alle gebieden

SCENARIO: Ontruiming zonder brand

Ontruimingstijd: 2,0 min

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6	15	20	30
Gang2 midden bg		-	-	-	-	-	-	-	-	-	-	-	-
Tr.1 oost dak		-	-	-	-	-	-	-	-	-	-	-	-
Tr.1 west dak		-	-	-	-	-	-	-	-	-	-	-	-
Tr.1 oost tusse		-	-	-	-	-	-	-	-	-	-	-	-
Tr.1 west tusse		-	-	-	-	-	-	-	-	-	-	-	-
Tr.2 oost dak		-	-	-	-	-	-	-	-	-	-	-	-
Tr.2 west dak		-	-	-	-	-	-	-	-	-	-	-	-
Tr.2 oost tusse		-	-	-	-	-	-	-	-	-	-	-	-
Tr.2 west tusse		-	-	-	-	-	-	-	-	-	-	-	-
Tr.1 oost 1e		-	2	-	-	-	-	-	-	-	-	-	-
Tr.1 west 1e		-	38	9	-	-	-	-	-	-	-	-	-
Tr.noord 1e		-	18	-	-	-	-	-	-	-	-	-	-
Tr.2 oost 1e		-	38	8	-	-	-	-	-	-	-	-	-
Tr.2 west 1e		-	33	2	-	-	-	-	-	-	-	-	-
Tr.1 oost mezza		-	-	2	-	-	-	-	-	-	-	-	-
Tr.1 west mezza		-	-	31	9	-	-	-	-	-	-	-	-
Tr.noord mezzan		-	-	18	-	-	-	-	-	-	-	-	-
Tr.2 oost mezza		-	-	31	8	-	-	-	-	-	-	-	-
Tr.2 west mezza		-	-	31	2	-	-	-	-	-	-	-	-
Tr.1 oost bg		-	8	-	-	-	-	-	-	-	-	-	-
Tr.noord bg		-	-	-	-	-	-	-	-	-	-	-	-
Tr.2 oost bg		-	11	-	9	-	-	-	-	-	-	-	-
Tr.2 west bg		-	3	-	9	-	-	-	-	-	-	-	-
Tr.1 west bg		-	12	-	9	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied 1e verd.A

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.A		-	-	-	-	-	-	-	-	-
1e verd.B		-	-	-	-	-	-	-	-	-
1e verd.C werkp		20	-	-	-	-	-	-	-	-
1e verd.D		4	-	-	-	-	-	-	-	-
1e verd.E		75	-	-	-	-	-	-	-	-
1e verd.F		33	-	-	-	-	-	-	-	-
1e verd.G		-	-	-	-	-	-	-	-	-
Begane grond A		7	-	-	-	-	-	-	-	-
Begane grond B		7	-	-	-	-	-	-	-	-
Begane grond C		7	-	-	-	-	-	-	-	-
Begane grond E		9	-	-	-	-	-	-	-	-
Begane grond F1		3	-	-	-	-	-	-	-	-
Begane grond F2		3	-	-	-	-	-	-	-	-
Begane grond F3		9	-	-	-	-	-	-	-	-
Begane grond G		21	-	-	-	-	-	-	-	-
Begane grond H		5	-	-	-	-	-	-	-	-
Begane grond I		15	-	-	-	-	-	-	-	-
Begane grond J		53	-	-	-	-	-	-	-	-
Begane grond L1		15	1	-	-	-	-	-	-	-
Begane grond L2		12	-	-	-	-	-	-	-	-
Gang noord 1e		-	-	-	-	-	-	-	-	-
Gang oost bg		-	-	-	-	-	-	-	-	-
Gang west1 1e		-	18	-	-	-	-	-	-	-
Gang west1 bg		-	-	-	-	-	-	-	-	-
Gang west2 1e		-	-	-	-	-	-	-	-	-
Gang west2 bg		-	-	-	-	-	-	-	-	-
Gang west3 bg		-	-	-	-	-	-	-	-	-
Gang1 midden bg		-	-	-	-	-	-	-	-	-
Gang2 midden bg		-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied 1e verd.B

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.A		-	-	-	-	-	-	-	-	-
1e verd.B		-	-	-	-	-	-	-	-	-
1e verd.C werkp		20	-	-	-	-	-	-	-	-
1e verd.D		4	-	-	-	-	-	-	-	-
1e verd.E		75	-	-	-	-	-	-	-	-
1e verd.F		33	-	-	-	-	-	-	-	-
1e verd.G		-	-	-	-	-	-	-	-	-
Begane grond A		7	-	-	-	-	-	-	-	-
Begane grond B		7	-	-	-	-	-	-	-	-
Begane grond C		7	-	-	-	-	-	-	-	-
Begane grond E		9	-	-	-	-	-	-	-	-
Begane grond F1		3	-	-	-	-	-	-	-	-
Begane grond F2		3	-	-	-	-	-	-	-	-
Begane grond F3		9	-	-	-	-	-	-	-	-
Begane grond G		21	-	-	-	-	-	-	-	-
Begane grond H		5	-	-	-	-	-	-	-	-
Begane grond I		15	-	-	-	-	-	-	-	-
Begane grond J		53	-	-	-	-	-	-	-	-
Begane grond L1		15	1	-	-	-	-	-	-	-
Begane grond L2		12	-	-	-	-	-	-	-	-
Gang noord 1e		-	-	-	-	-	-	-	-	-
Gang oost bg		-	-	-	-	-	-	-	-	-
Gang west1 1e		-	-	-	-	-	-	-	-	-
Gang west1 bg		-	-	-	-	-	-	-	-	-
Gang west2 1e		-	-	-	-	-	-	-	-	-
Gang west2 bg		-	-	-	-	-	-	-	-	-
Gang west3 bg		-	-	-	-	-	-	-	-	-
Gang1 midden bg		-	-	-	-	-	-	-	-	-
Gang2 midden bg		-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied 1e verd.C werkp

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.A		-	-	-	-	-	-	-	-	-
1e verd.C werkp		20	-	-	-	-	-	-	-	-
1e verd.D		4	-	-	-	-	-	-	-	-
1e verd.E		75	-	-	-	-	-	-	-	-
1e verd.F		33	1	-	-	-	-	-	-	-
1e verd.G		-	-	-	-	-	-	-	-	-
Begane grond A		7	-	-	-	-	-	-	-	-
Begane grond B		7	-	-	-	-	-	-	-	-
Begane grond C		7	-	-	-	-	-	-	-	-
Begane grond E		9	-	-	-	-	-	-	-	-
Begane grond F1		3	-	-	-	-	-	-	-	-
Begane grond F2		3	-	-	-	-	-	-	-	-
Begane grond F3		9	-	-	-	-	-	-	-	-
Begane grond G		21	-	-	-	-	-	-	-	-
Begane grond H		5	-	-	-	-	-	-	-	-
Begane grond I		15	-	-	-	-	-	-	-	-
Begane grond J		53	-	-	-	-	-	-	-	-
Begane grond L1		15	-	-	-	-	-	-	-	-
Begane grond L2		12	-	-	-	-	-	-	-	-
Gang noord 1e		-	-	-	-	-	-	-	-	-
Gang oost bg		-	-	-	-	-	-	-	-	-
Gang west1 1e		-	2	-	-	-	-	-	-	-
Gang west1 bg		-	-	-	-	-	-	-	-	-
Gang west2 1e		-	-	-	-	-	-	-	-	-
Gang west2 bg		-	-	-	-	-	-	-	-	-
Gang west3 bg		-	-	-	-	-	-	-	-	-
Gang1 midden bg		-	-	-	-	-	-	-	-	-
Gang2 midden bg		-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied 1e verd.D

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.D	4	-	-	-	-	-	-	-	-	-
1e verd.E	75	-	-	-	-	-	-	-	-	-
1e verd.F	33	1	-	-	-	-	-	-	-	-
1e verd.G	-	-	-	-	-	-	-	-	-	-
Begane grond A	7	-	-	-	-	-	-	-	-	-
Begane grond B	7	-	-	-	-	-	-	-	-	-
Begane grond C	7	-	-	-	-	-	-	-	-	-
Begane grond E	9	-	-	-	-	-	-	-	-	-
Begane grond F1	3	-	-	-	-	-	-	-	-	-
Begane grond F2	3	-	-	-	-	-	-	-	-	-
Begane grond F3	9	-	-	-	-	-	-	-	-	-
Begane grond G	21	-	-	-	-	-	-	-	-	-
Begane grond H	5	-	-	-	-	-	-	-	-	-
Begane grond I	15	-	-	-	-	-	-	-	-	-
Begane grond J	53	-	-	-	-	-	-	-	-	-
Begane grond L1	15	-	-	-	-	-	-	-	-	-
Begane grond L2	12	-	-	-	-	-	-	-	-	-
Gang oost bg	-	-	-	-	-	-	-	-	-	-
Gang west1 1e	-	2	-	-	-	-	-	-	-	-
Gang west1 bg	-	-	-	-	-	-	-	-	-	-
Gang west2 1e	-	-	-	-	-	-	-	-	-	-
Gang west2 bg	-	-	-	-	-	-	-	-	-	-
Gang west3 bg	-	-	-	-	-	-	-	-	-	-
Gang1 midden bg	-	-	-	-	-	-	-	-	-	-
Gang2 midden bg	-	-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied 1e verd.E

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.D	4	-	-	-	-	-	-	-	-	-
1e verd.E	75	-	-	-	-	-	-	-	-	-
1e verd.F	33	1	-	-	-	-	-	-	-	-
1e verd.G	-	-	-	-	-	-	-	-	-	-
Begane grond A	7	-	-	-	-	-	-	-	-	-
Begane grond B	7	-	-	-	-	-	-	-	-	-
Begane grond C	7	-	-	-	-	-	-	-	-	-
Begane grond E	9	-	-	-	-	-	-	-	-	-
Begane grond F1	3	-	-	-	-	-	-	-	-	-
Begane grond F2	3	-	-	-	-	-	-	-	-	-
Begane grond F3	9	-	-	-	-	-	-	-	-	-
Begane grond G	21	-	-	-	-	-	-	-	-	-
Begane grond H	5	-	-	-	-	-	-	-	-	-
Begane grond I	15	-	-	-	-	-	-	-	-	-
Begane grond J	53	-	-	-	-	-	-	-	-	-
Begane grond L1	15	-	-	-	-	-	-	-	-	-
Begane grond L2	12	-	-	-	-	-	-	-	-	-
Gang oost bg	-	-	-	-	-	-	-	-	-	-
Gang west1 1e	-	3	-	-	-	-	-	-	-	-
Gang west1 bg	-	-	-	-	-	-	-	-	-	-
Gang west2 1e	-	-	-	-	-	-	-	-	-	-
Gang west2 bg	-	-	-	-	-	-	-	-	-	-
Gang west3 bg	-	-	-	-	-	-	-	-	-	-
Gang1 midden bg	-	-	-	-	-	-	-	-	-	-
Gang2 midden bg	-	-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied 1e verd.F

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.A		-	-	-	-	-	-	-	-	-
1e verd.C werkp		20	-	-	-	-	-	-	-	-
1e verd.D		4	-	-	-	-	-	-	-	-
1e verd.E		75	9	-	-	-	-	-	-	-
1e verd.F		33	-	-	-	-	-	-	-	-
1e verd.G		-	-	-	-	-	-	-	-	-
Begane grond A		7	-	-	-	-	-	-	-	-
Begane grond B		7	-	-	-	-	-	-	-	-
Begane grond C		7	-	-	-	-	-	-	-	-
Begane grond E		9	-	-	-	-	-	-	-	-
Begane grond F1		3	-	-	-	-	-	-	-	-
Begane grond F2		3	-	-	-	-	-	-	-	-
Begane grond F3		9	-	-	-	-	-	-	-	-
Begane grond G		21	-	-	-	-	-	-	-	-
Begane grond H		5	-	-	-	-	-	-	-	-
Begane grond I		15	-	-	-	-	-	-	-	-
Begane grond J		53	-	-	-	-	-	-	-	-
Begane grond L1		15	6	-	-	-	-	-	-	-
Begane grond L2		12	11	-	-	-	-	-	-	-
Gang noord 1e		-	-	-	-	-	-	-	-	-
Gang oost bg		-	-	-	-	-	-	-	-	-
Gang west1 1e		-	11	-	-	-	-	-	-	-
Gang west1 bg		-	-	-	-	-	-	-	-	-
Gang west2 1e		-	-	-	-	-	-	-	-	-
Gang west2 bg		-	-	-	-	-	-	-	-	-
Gang west3 bg		-	-	-	-	-	-	-	-	-
Gang1 midden bg		-	-	-	-	-	-	-	-	-
Gang2 midden bg		-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied 1e verd.G

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.B		-	-	-	-	-	-	-	-	-
1e verd.D		4	-	-	-	-	-	-	-	-
1e verd.E		75	-	-	-	-	-	-	-	-
1e verd.F		33	1	-	-	-	-	-	-	-
1e verd.G		-	-	-	-	-	-	-	-	-
Begane grond A		7	-	-	-	-	-	-	-	-
Begane grond B		7	-	-	-	-	-	-	-	-
Begane grond C		7	-	-	-	-	-	-	-	-
Begane grond E		9	-	-	-	-	-	-	-	-
Begane grond F1		3	-	-	-	-	-	-	-	-
Begane grond F2		3	-	-	-	-	-	-	-	-
Begane grond F3		9	-	-	-	-	-	-	-	-
Begane grond G		21	-	-	-	-	-	-	-	-
Begane grond H		5	-	-	-	-	-	-	-	-
Begane grond I		15	-	-	-	-	-	-	-	-
Begane grond J		53	-	-	-	-	-	-	-	-
Begane grond L1		15	-	-	-	-	-	-	-	-
Begane grond L2		12	-	-	-	-	-	-	-	-
Gang oost bg		-	-	-	-	-	-	-	-	-
Gang west1 1e		-	1	-	-	-	-	-	-	-
Gang west1 bg		-	-	-	-	-	-	-	-	-
Gang west2 1e		-	-	-	-	-	-	-	-	-
Gang west2 bg		-	-	-	-	-	-	-	-	-
Gang west3 bg		-	-	-	-	-	-	-	-	-
Gang1 midden bg		-	-	-	-	-	-	-	-	-
Gang2 midden bg		-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Begane grond A

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.D		4	-	-	-	-	-	-	-	-
1e verd.E		75	-	-	-	-	-	-	-	-
1e verd.F		33	1	-	-	-	-	-	-	-
1e verd.G		-	-	-	-	-	-	-	-	-
Begane grond A		7	-	-	-	-	-	-	-	-
Begane grond B		7	-	-	-	-	-	-	-	-
Begane grond C		7	-	-	-	-	-	-	-	-
Begane grond E		9	-	-	-	-	-	-	-	-
Begane grond F1		3	-	-	-	-	-	-	-	-
Begane grond F2		3	-	-	-	-	-	-	-	-
Begane grond F3		9	-	-	-	-	-	-	-	-
Begane grond G		21	-	-	-	-	-	-	-	-
Begane grond H		5	-	-	-	-	-	-	-	-
Begane grond I		15	-	-	-	-	-	-	-	-
Begane grond J		53	-	-	-	-	-	-	-	-
Begane grond L1		15	-	-	-	-	-	-	-	-
Begane grond L2		12	-	-	-	-	-	-	-	-
Begane grond M		6	-	-	-	-	-	-	-	-
Gang oost bg		-	-	-	-	-	-	-	-	-
Gang west1 1e		-	2	-	-	-	-	-	-	-
Gang west1 bg		-	-	-	-	-	-	-	-	-
Gang west2 1e		-	-	-	-	-	-	-	-	-
Gang west2 bg		-	-	-	-	-	-	-	-	-
Gang west3 bg		-	-	-	-	-	-	-	-	-
Gang1 midden bg		-	-	-	-	-	-	-	-	-
Gang2 midden bg		-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Begane grond B

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.D	4	-	-	-	-	-	-	-	-	-
1e verd.E	75	-	-	-	-	-	-	-	-	-
1e verd.F	33	1	-	-	-	-	-	-	-	-
1e verd.G	-	-	-	-	-	-	-	-	-	-
Begane grond A	7	-	-	-	-	-	-	-	-	-
Begane grond B	7	-	-	-	-	-	-	-	-	-
Begane grond C	7	-	-	-	-	-	-	-	-	-
Begane grond E	9	-	-	-	-	-	-	-	-	-
Begane grond F1	3	-	-	-	-	-	-	-	-	-
Begane grond F2	3	-	-	-	-	-	-	-	-	-
Begane grond F3	9	-	-	-	-	-	-	-	-	-
Begane grond G	21	-	-	-	-	-	-	-	-	-
Begane grond H	5	-	-	-	-	-	-	-	-	-
Begane grond I	15	-	-	-	-	-	-	-	-	-
Begane grond J	53	-	-	-	-	-	-	-	-	-
Begane grond L1	15	-	-	-	-	-	-	-	-	-
Begane grond L2	12	-	-	-	-	-	-	-	-	-
Begane grond M	6	-	-	-	-	-	-	-	-	-
Gang oost bg	-	-	-	-	-	-	-	-	-	-
Gang west1 1e	-	2	-	-	-	-	-	-	-	-
Gang west1 bg	-	-	-	-	-	-	-	-	-	-
Gang west2 1e	-	-	-	-	-	-	-	-	-	-
Gang west2 bg	-	-	-	-	-	-	-	-	-	-
Gang west3 bg	-	-	-	-	-	-	-	-	-	-
Gang1 midden bg	-	-	-	-	-	-	-	-	-	-
Gang2 midden bg	-	-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Begane grond C

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.D		4	-	-	-	-	-	-	-	-
1e verd.E		75	-	-	-	-	-	-	-	-
1e verd.F		33	1	-	-	-	-	-	-	-
1e verd.G		-	-	-	-	-	-	-	-	-
Begane grond A		7	-	-	-	-	-	-	-	-
Begane grond B		7	-	-	-	-	-	-	-	-
Begane grond C		7	-	-	-	-	-	-	-	-
Begane grond E		9	-	-	-	-	-	-	-	-
Begane grond F1		3	-	-	-	-	-	-	-	-
Begane grond F2		3	-	-	-	-	-	-	-	-
Begane grond F3		9	-	-	-	-	-	-	-	-
Begane grond G		21	-	-	-	-	-	-	-	-
Begane grond H		5	-	-	-	-	-	-	-	-
Begane grond I		15	-	-	-	-	-	-	-	-
Begane grond J		53	-	-	-	-	-	-	-	-
Begane grond L1		15	-	-	-	-	-	-	-	-
Begane grond L2		12	-	-	-	-	-	-	-	-
Begane grond M		6	-	-	-	-	-	-	-	-
Gang oost bg		-	-	-	-	-	-	-	-	-
Gang west1 1e		-	2	-	-	-	-	-	-	-
Gang west1 bg		-	-	-	-	-	-	-	-	-
Gang west2 1e		-	-	-	-	-	-	-	-	-
Gang west2 bg		-	-	-	-	-	-	-	-	-
Gang west3 bg		-	-	-	-	-	-	-	-	-
Gang1 midden bg		-	-	-	-	-	-	-	-	-
Gang2 midden bg		-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Begane grond E

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.D	4	-	-	-	-	-	-	-	-	-
1e verd.E	75	-	-	-	-	-	-	-	-	-
1e verd.F	33	1	-	-	-	-	-	-	-	-
1e verd.G	-	-	-	-	-	-	-	-	-	-
Begane grond A	7	-	-	-	-	-	-	-	-	-
Begane grond B	7	-	-	-	-	-	-	-	-	-
Begane grond C	7	-	-	-	-	-	-	-	-	-
Begane grond E	9	-	-	-	-	-	-	-	-	-
Begane grond F1	3	-	-	-	-	-	-	-	-	-
Begane grond F2	3	-	-	-	-	-	-	-	-	-
Begane grond F3	9	-	-	-	-	-	-	-	-	-
Begane grond G	21	-	-	-	-	-	-	-	-	-
Begane grond H	5	-	-	-	-	-	-	-	-	-
Begane grond I	15	-	-	-	-	-	-	-	-	-
Begane grond J	53	-	-	-	-	-	-	-	-	-
Begane grond L1	15	-	-	-	-	-	-	-	-	-
Begane grond L2	12	-	-	-	-	-	-	-	-	-
Gang oost bg	-	-	-	-	-	-	-	-	-	-
Gang west1 1e	-	2	-	-	-	-	-	-	-	-
Gang west1 bg	-	-	-	-	-	-	-	-	-	-
Gang west2 1e	-	-	-	-	-	-	-	-	-	-
Gang west2 bg	-	-	-	-	-	-	-	-	-	-
Gang west3 bg	-	-	-	-	-	-	-	-	-	-
Gang1 midden bg	-	-	-	-	-	-	-	-	-	-
Gang2 midden bg	-	-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Begane grond F1

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.D	4	-	-	-	-	-	-	-	-	-
1e verd.E	75	-	-	-	-	-	-	-	-	-
1e verd.F	33	1	-	-	-	-	-	-	-	-
1e verd.G	-	-	-	-	-	-	-	-	-	-
Begane grond A	7	-	-	-	-	-	-	-	-	-
Begane grond B	7	-	-	-	-	-	-	-	-	-
Begane grond C	7	-	-	-	-	-	-	-	-	-
Begane grond E	9	-	-	-	-	-	-	-	-	-
Begane grond F1	3	-	-	-	-	-	-	-	-	-
Begane grond F2	3	-	-	-	-	-	-	-	-	-
Begane grond F3	9	-	-	-	-	-	-	-	-	-
Begane grond G	21	-	-	-	-	-	-	-	-	-
Begane grond H	5	-	-	-	-	-	-	-	-	-
Begane grond I	15	-	-	-	-	-	-	-	-	-
Begane grond J	53	-	-	-	-	-	-	-	-	-
Begane grond L1	15	-	-	-	-	-	-	-	-	-
Begane grond L2	12	-	-	-	-	-	-	-	-	-
Gang oost bg	-	-	-	-	-	-	-	-	-	-
Gang west1 1e	-	2	-	-	-	-	-	-	-	-
Gang west1 bg	-	-	-	-	-	-	-	-	-	-
Gang west2 1e	-	-	-	-	-	-	-	-	-	-
Gang west2 bg	-	-	-	-	-	-	-	-	-	-
Gang west3 bg	-	-	-	-	-	-	-	-	-	-
Gang1 midden bg	-	-	-	-	-	-	-	-	-	-
Gang2 midden bg	-	-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Begane grond F2

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.D	4	-	-	-	-	-	-	-	-	-
1e verd.E	75	-	-	-	-	-	-	-	-	-
1e verd.F	33	1	-	-	-	-	-	-	-	-
1e verd.G	-	-	-	-	-	-	-	-	-	-
Begane grond A	7	-	-	-	-	-	-	-	-	-
Begane grond B	7	-	-	-	-	-	-	-	-	-
Begane grond C	7	-	-	-	-	-	-	-	-	-
Begane grond E	9	-	-	-	-	-	-	-	-	-
Begane grond F1	3	-	-	-	-	-	-	-	-	-
Begane grond F2	3	-	-	-	-	-	-	-	-	-
Begane grond F3	9	-	-	-	-	-	-	-	-	-
Begane grond G	21	-	-	-	-	-	-	-	-	-
Begane grond H	5	-	-	-	-	-	-	-	-	-
Begane grond I	15	-	-	-	-	-	-	-	-	-
Begane grond J	53	-	-	-	-	-	-	-	-	-
Begane grond L1	15	-	-	-	-	-	-	-	-	-
Begane grond L2	12	-	-	-	-	-	-	-	-	-
Gang oost bg	-	-	-	-	-	-	-	-	-	-
Gang west1 1e	-	2	-	-	-	-	-	-	-	-
Gang west1 bg	-	-	-	-	-	-	-	-	-	-
Gang west2 1e	-	-	-	-	-	-	-	-	-	-
Gang west2 bg	-	-	-	-	-	-	-	-	-	-
Gang west3 bg	-	-	-	-	-	-	-	-	-	-
Gang1 midden bg	-	-	-	-	-	-	-	-	-	-
Gang2 midden bg	-	-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Begane grond F3

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.D	4	-	-	-	-	-	-	-	-	-
1e verd.E	75	-	-	-	-	-	-	-	-	-
1e verd.F	33	1	-	-	-	-	-	-	-	-
1e verd.G	-	-	-	-	-	-	-	-	-	-
Begane grond A	7	-	-	-	-	-	-	-	-	-
Begane grond B	7	-	-	-	-	-	-	-	-	-
Begane grond C	7	-	-	-	-	-	-	-	-	-
Begane grond E	9	-	-	-	-	-	-	-	-	-
Begane grond F1	3	-	-	-	-	-	-	-	-	-
Begane grond F2	3	-	-	-	-	-	-	-	-	-
Begane grond F3	9	-	-	-	-	-	-	-	-	-
Begane grond G	21	-	-	-	-	-	-	-	-	-
Begane grond H	5	-	-	-	-	-	-	-	-	-
Begane grond I	15	-	-	-	-	-	-	-	-	-
Begane grond J	53	-	-	-	-	-	-	-	-	-
Begane grond L1	15	-	-	-	-	-	-	-	-	-
Begane grond L2	12	-	-	-	-	-	-	-	-	-
Gang oost bg	-	-	-	-	-	-	-	-	-	-
Gang west1 1e	-	2	-	-	-	-	-	-	-	-
Gang west1 bg	-	-	-	-	-	-	-	-	-	-
Gang west2 1e	-	-	-	-	-	-	-	-	-	-
Gang west2 bg	-	-	-	-	-	-	-	-	-	-
Gang west3 bg	-	-	-	-	-	-	-	-	-	-
Gang1 midden bg	-	-	-	-	-	-	-	-	-	-
Gang2 midden bg	-	-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Begane grond G

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.D		4	-	-	-	-	-	-	-	-
1e verd.E		75	-	-	-	-	-	-	-	-
1e verd.F		33	1	-	-	-	-	-	-	-
1e verd.G		-	-	-	-	-	-	-	-	-
Begane grond A		7	-	-	-	-	-	-	-	-
Begane grond B		7	-	-	-	-	-	-	-	-
Begane grond C		7	-	-	-	-	-	-	-	-
Begane grond E		9	-	-	-	-	-	-	-	-
Begane grond F1		3	-	-	-	-	-	-	-	-
Begane grond F2		3	-	-	-	-	-	-	-	-
Begane grond F3		9	-	-	-	-	-	-	-	-
Begane grond G		21	-	-	-	-	-	-	-	-
Begane grond H		5	-	-	-	-	-	-	-	-
Begane grond I		15	-	-	-	-	-	-	-	-
Begane grond J		53	-	-	-	-	-	-	-	-
Begane grond L1		15	-	-	-	-	-	-	-	-
Begane grond L2		12	-	-	-	-	-	-	-	-
Gang oost bg		-	-	-	-	-	-	-	-	-
Gang west1 1e		-	2	-	-	-	-	-	-	-
Gang west1 bg		-	-	-	-	-	-	-	-	-
Gang west2 1e		-	-	-	-	-	-	-	-	-
Gang west2 bg		-	-	-	-	-	-	-	-	-
Gang west3 bg		-	-	-	-	-	-	-	-	-
Gang1 midden bg		-	-	-	-	-	-	-	-	-
Gang2 midden bg		-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Begane grond H

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.D	4	-	-	-	-	-	-	-	-	-
1e verd.E	75	-	-	-	-	-	-	-	-	-
1e verd.F	33	1	-	-	-	-	-	-	-	-
1e verd.G	-	-	-	-	-	-	-	-	-	-
Begane grond A	7	-	-	-	-	-	-	-	-	-
Begane grond B	7	-	-	-	-	-	-	-	-	-
Begane grond C	7	-	-	-	-	-	-	-	-	-
Begane grond E	9	-	-	-	-	-	-	-	-	-
Begane grond F1	3	-	-	-	-	-	-	-	-	-
Begane grond F2	3	-	-	-	-	-	-	-	-	-
Begane grond F3	9	-	-	-	-	-	-	-	-	-
Begane grond G	21	-	-	-	-	-	-	-	-	-
Begane grond H	5	-	-	-	-	-	-	-	-	-
Begane grond I	15	-	-	-	-	-	-	-	-	-
Begane grond J	53	-	-	-	-	-	-	-	-	-
Begane grond L1	15	-	-	-	-	-	-	-	-	-
Begane grond L2	12	-	-	-	-	-	-	-	-	-
Gang oost bg	-	-	-	-	-	-	-	-	-	-
Gang west1 1e	-	2	-	-	-	-	-	-	-	-
Gang west1 bg	-	-	-	-	-	-	-	-	-	-
Gang west2 1e	-	-	-	-	-	-	-	-	-	-
Gang west2 bg	-	-	-	-	-	-	-	-	-	-
Gang west3 bg	-	-	-	-	-	-	-	-	-	-
Gang1 midden bg	-	-	-	-	-	-	-	-	-	-
Gang2 midden bg	-	-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Begane grond I

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.D	4	-	-	-	-	-	-	-	-	-
1e verd.E	75	-	-	-	-	-	-	-	-	-
1e verd.F	33	1	-	-	-	-	-	-	-	-
1e verd.G	-	-	-	-	-	-	-	-	-	-
Begane grond A	7	-	-	-	-	-	-	-	-	-
Begane grond B	7	-	-	-	-	-	-	-	-	-
Begane grond C	7	-	-	-	-	-	-	-	-	-
Begane grond E	9	-	-	-	-	-	-	-	-	-
Begane grond F1	3	-	-	-	-	-	-	-	-	-
Begane grond F2	3	-	-	-	-	-	-	-	-	-
Begane grond F3	9	-	-	-	-	-	-	-	-	-
Begane grond G	21	-	-	-	-	-	-	-	-	-
Begane grond H	5	-	-	-	-	-	-	-	-	-
Begane grond I	15	-	-	-	-	-	-	-	-	-
Begane grond J	53	-	-	-	-	-	-	-	-	-
Begane grond L1	15	-	-	-	-	-	-	-	-	-
Begane grond L2	12	-	-	-	-	-	-	-	-	-
Gang oost bg	-	-	-	-	-	-	-	-	-	-
Gang west1 1e	-	2	-	-	-	-	-	-	-	-
Gang west1 bg	-	-	-	-	-	-	-	-	-	-
Gang west2 1e	-	-	-	-	-	-	-	-	-	-
Gang west2 bg	-	-	-	-	-	-	-	-	-	-
Gang west3 bg	-	-	-	-	-	-	-	-	-	-
Gang1 midden bg	-	-	-	-	-	-	-	-	-	-
Gang2 midden bg	-	-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Begane grond J

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.A		-	-	-	-	-	-	-	-	-
1e verd.C werkp		20	-	-	-	-	-	-	-	-
1e verd.D		4	-	-	-	-	-	-	-	-
1e verd.E		75	9	-	-	-	-	-	-	-
1e verd.F		33	-	-	-	-	-	-	-	-
1e verd.G		-	-	-	-	-	-	-	-	-
Begane grond A		7	-	-	-	-	-	-	-	-
Begane grond B		7	-	-	-	-	-	-	-	-
Begane grond C		7	-	-	-	-	-	-	-	-
Begane grond E		9	-	-	-	-	-	-	-	-
Begane grond F1		3	-	-	-	-	-	-	-	-
Begane grond F2		3	-	-	-	-	-	-	-	-
Begane grond F3		9	-	-	-	-	-	-	-	-
Begane grond G		21	-	-	-	-	-	-	-	-
Begane grond H		5	-	-	-	-	-	-	-	-
Begane grond I		15	-	-	-	-	-	-	-	-
Begane grond J		53	-	-	-	-	-	-	-	-
Begane grond L1		15	4	-	-	-	-	-	-	-
Begane grond L2		12	10	-	-	-	-	-	-	-
Gang noord 1e		-	-	-	-	-	-	-	-	-
Gang oost bg		-	-	-	-	-	-	-	-	-
Gang west1 1e		-	12	-	-	-	-	-	-	-
Gang west1 bg		-	-	-	-	-	-	-	-	-
Gang west2 1e		-	-	-	-	-	-	-	-	-
Gang west2 bg		-	-	-	-	-	-	-	-	-
Gang west3 bg		-	-	-	-	-	-	-	-	-
Gang1 midden bg		-	-	-	-	-	-	-	-	-
Gang2 midden bg		-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Begane grond L1

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.D	4	-	-	-	-	-	-	-	-	-
1e verd.E	75	-	-	-	-	-	-	-	-	-
1e verd.F	33	1	-	-	-	-	-	-	-	-
1e verd.G	-	-	-	-	-	-	-	-	-	-
Begane grond A	7	-	-	-	-	-	-	-	-	-
Begane grond B	7	-	-	-	-	-	-	-	-	-
Begane grond C	7	-	-	-	-	-	-	-	-	-
Begane grond E	9	-	-	-	-	-	-	-	-	-
Begane grond F1	3	-	-	-	-	-	-	-	-	-
Begane grond F2	3	-	-	-	-	-	-	-	-	-
Begane grond F3	9	-	-	-	-	-	-	-	-	-
Begane grond G	21	-	-	-	-	-	-	-	-	-
Begane grond H	5	-	-	-	-	-	-	-	-	-
Begane grond I	15	-	-	-	-	-	-	-	-	-
Begane grond J	53	-	-	-	-	-	-	-	-	-
Begane grond L1	15	-	-	-	-	-	-	-	-	-
Begane grond L2	12	-	-	-	-	-	-	-	-	-
Begane grond M	6	-	-	-	-	-	-	-	-	-
Gang oost bg	-	-	-	-	-	-	-	-	-	-
Gang west1 1e	-	2	-	-	-	-	-	-	-	-
Gang west1 bg	-	-	-	-	-	-	-	-	-	-
Gang west2 1e	-	-	-	-	-	-	-	-	-	-
Gang west2 bg	-	-	-	-	-	-	-	-	-	-
Gang west3 bg	-	-	-	-	-	-	-	-	-	-
Gang1 midden bg	-	-	-	-	-	-	-	-	-	-
Gang2 midden bg	-	35	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Begane grond L2

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.D	4	-	-	-	-	-	-	-	-	-
1e verd.E	75	-	-	-	-	-	-	-	-	-
1e verd.F	33	1	-	-	-	-	-	-	-	-
1e verd.G	-	-	-	-	-	-	-	-	-	-
Begane grond A	7	-	-	-	-	-	-	-	-	-
Begane grond B	7	-	-	-	-	-	-	-	-	-
Begane grond C	7	-	-	-	-	-	-	-	-	-
Begane grond E	9	-	-	-	-	-	-	-	-	-
Begane grond F1	3	-	-	-	-	-	-	-	-	-
Begane grond F2	3	-	-	-	-	-	-	-	-	-
Begane grond F3	9	-	-	-	-	-	-	-	-	-
Begane grond G	21	-	-	-	-	-	-	-	-	-
Begane grond H	5	-	-	-	-	-	-	-	-	-
Begane grond I	15	-	-	-	-	-	-	-	-	-
Begane grond J	53	-	-	-	-	-	-	-	-	-
Begane grond L1	15	-	-	-	-	-	-	-	-	-
Begane grond L2	12	-	-	-	-	-	-	-	-	-
Begane grond M	6	-	-	-	-	-	-	-	-	-
Gang oost bg	-	-	-	-	-	-	-	-	-	-
Gang west1 1e	-	2	-	-	-	-	-	-	-	-
Gang west1 bg	-	-	-	-	-	-	-	-	-	-
Gang west2 1e	-	-	-	-	-	-	-	-	-	-
Gang west2 bg	-	-	-	-	-	-	-	-	-	-
Gang west3 bg	-	-	-	-	-	-	-	-	-	-
Gang1 midden bg	-	-	-	-	-	-	-	-	-	-
Gang2 midden bg	-	33	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Begane grond M

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.D	4	-	-	-	-	-	-	-	-	-
1e verd.E	75	-	-	-	-	-	-	-	-	-
1e verd.F	33	1	-	-	-	-	-	-	-	-
1e verd.G	-	-	-	-	-	-	-	-	-	-
Begane grond A	7	-	-	-	-	-	-	-	-	-
Begane grond B	7	-	-	-	-	-	-	-	-	-
Begane grond C	7	-	-	-	-	-	-	-	-	-
Begane grond E	9	-	-	-	-	-	-	-	-	-
Begane grond F1	3	-	-	-	-	-	-	-	-	-
Begane grond F2	3	-	-	-	-	-	-	-	-	-
Begane grond F3	9	-	-	-	-	-	-	-	-	-
Begane grond G	21	-	-	-	-	-	-	-	-	-
Begane grond H	5	-	-	-	-	-	-	-	-	-
Begane grond I	15	-	-	-	-	-	-	-	-	-
Begane grond J	53	-	-	-	-	-	-	-	-	-
Begane grond L1	15	-	-	-	-	-	-	-	-	-
Begane grond L2	12	-	-	-	-	-	-	-	-	-
Begane grond M	6	-	-	-	-	-	-	-	-	-
Gang oost bg	-	-	-	-	-	-	-	-	-	-
Gang west1 1e	-	2	-	-	-	-	-	-	-	-
Gang west1 bg	-	-	-	-	-	-	-	-	-	-
Gang west2 1e	-	-	-	-	-	-	-	-	-	-
Gang west2 bg	-	-	-	-	-	-	-	-	-	-
Gang west3 bg	-	-	-	-	-	-	-	-	-	-
Gang1 midden bg	-	-	-	-	-	-	-	-	-	-
Gang2 midden bg	-	-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Gang noord 1e

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.A		-	-	-	-	-	-	-	-	-
1e verd.B		-	-	-	-	-	-	-	-	-
1e verd.C werkp		20	-	-	-	-	-	-	-	-
Gang noord 1e		-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Gang oost bg

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.D	4	-	-	-	-	-	-	-	-	-
1e verd.E	75	-	-	-	-	-	-	-	-	-
1e verd.F	33	1	-	-	-	-	-	-	-	-
1e verd.G	-	-	-	-	-	-	-	-	-	-
Begane grond A	7	-	-	-	-	-	-	-	-	-
Begane grond B	7	-	-	-	-	-	-	-	-	-
Begane grond C	7	-	-	-	-	-	-	-	-	-
Begane grond E	9	-	-	-	-	-	-	-	-	-
Begane grond F1	3	-	-	-	-	-	-	-	-	-
Begane grond F2	3	-	-	-	-	-	-	-	-	-
Begane grond F3	9	-	-	-	-	-	-	-	-	-
Begane grond G	21	-	-	-	-	-	-	-	-	-
Begane grond H	5	-	-	-	-	-	-	-	-	-
Begane grond I	15	-	-	-	-	-	-	-	-	-
Begane grond J	53	-	-	-	-	-	-	-	-	-
Begane grond L1	15	-	-	-	-	-	-	-	-	-
Begane grond L2	12	-	-	-	-	-	-	-	-	-
Begane grond M	6	-	-	-	-	-	-	-	-	-
Gang oost bg	-	-	-	-	-	-	-	-	-	-
Gang west1 1e	-	2	-	-	-	-	-	-	-	-
Gang west1 bg	-	-	-	-	-	-	-	-	-	-
Gang west2 1e	-	-	-	-	-	-	-	-	-	-
Gang west2 bg	-	-	-	-	-	-	-	-	-	-
Gang west3 bg	-	-	-	-	-	-	-	-	-	-
Gang1 midden bg	-	-	-	-	-	-	-	-	-	-
Gang2 midden bg	-	-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Gang west1 1e

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.A		-	-	-	-	-	-	-	-	-
1e verd.C werkp		20	-	-	-	-	-	-	-	-
1e verd.D		4	-	-	-	-	-	-	-	-
1e verd.E		75	18	-	-	-	-	-	-	-
1e verd.F		33	18	-	-	-	-	-	-	-
1e verd.G		-	-	-	-	-	-	-	-	-
Begane grond A		7	-	-	-	-	-	-	-	-
Begane grond B		7	-	-	-	-	-	-	-	-
Begane grond C		7	-	-	-	-	-	-	-	-
Begane grond E		9	-	-	-	-	-	-	-	-
Begane grond F1		3	-	-	-	-	-	-	-	-
Begane grond F2		3	-	-	-	-	-	-	-	-
Begane grond F3		9	-	-	-	-	-	-	-	-
Begane grond G		21	-	-	-	-	-	-	-	-
Begane grond H		5	-	-	-	-	-	-	-	-
Begane grond I		15	-	-	-	-	-	-	-	-
Begane grond J		53	-	-	-	-	-	-	-	-
Begane grond L1		15	-	-	-	-	-	-	-	-
Begane grond L2		12	-	-	-	-	-	-	-	-
Gang noord 1e		-	-	-	-	-	-	-	-	-
Gang oost bg		-	-	-	-	-	-	-	-	-
Gang west1 1e		-	-	-	-	-	-	-	-	-
Gang west1 bg		-	-	-	-	-	-	-	-	-
Gang west2 1e		-	-	-	-	-	-	-	-	-
Gang west2 bg		-	-	-	-	-	-	-	-	-
Gang west3 bg		-	-	-	-	-	-	-	-	-
Gang1 midden bg		-	-	-	-	-	-	-	-	-
Gang2 midden bg		-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Gang west1 bg

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.D	4	-	-	-	-	-	-	-	-	-
1e verd.E	75	-	-	-	-	-	-	-	-	-
1e verd.F	33	1	-	-	-	-	-	-	-	-
1e verd.G	-	-	-	-	-	-	-	-	-	-
Begane grond A	7	-	-	-	-	-	-	-	-	-
Begane grond B	7	-	-	-	-	-	-	-	-	-
Begane grond C	7	-	-	-	-	-	-	-	-	-
Begane grond E	9	-	-	-	-	-	-	-	-	-
Begane grond F1	3	-	-	-	-	-	-	-	-	-
Begane grond F2	3	-	-	-	-	-	-	-	-	-
Begane grond F3	9	-	-	-	-	-	-	-	-	-
Begane grond G	21	-	-	-	-	-	-	-	-	-
Begane grond H	5	-	-	-	-	-	-	-	-	-
Begane grond I	15	-	-	-	-	-	-	-	-	-
Begane grond J	53	-	-	-	-	-	-	-	-	-
Begane grond L1	15	-	-	-	-	-	-	-	-	-
Begane grond L2	12	-	-	-	-	-	-	-	-	-
Gang oost bg	-	-	-	-	-	-	-	-	-	-
Gang west1 1e	-	2	-	-	-	-	-	-	-	-
Gang west1 bg	-	-	-	-	-	-	-	-	-	-
Gang west2 1e	-	-	-	-	-	-	-	-	-	-
Gang west2 bg	-	-	-	-	-	-	-	-	-	-
Gang west3 bg	-	-	-	-	-	-	-	-	-	-
Gang1 midden bg	-	-	-	-	-	-	-	-	-	-
Gang2 midden bg	-	-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Gang west2 1e

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.A		-	-	-	-	-	-	-	-	-
1e verd.C werkp		20	-	-	-	-	-	-	-	-
1e verd.D		4	-	-	-	-	-	-	-	-
1e verd.E		75	-	-	-	-	-	-	-	-
1e verd.F		33	1	-	-	-	-	-	-	-
1e verd.G		-	-	-	-	-	-	-	-	-
Begane grond A		7	-	-	-	-	-	-	-	-
Begane grond B		7	-	-	-	-	-	-	-	-
Begane grond C		7	-	-	-	-	-	-	-	-
Begane grond E		9	-	-	-	-	-	-	-	-
Begane grond F1		3	-	-	-	-	-	-	-	-
Begane grond F2		3	-	-	-	-	-	-	-	-
Begane grond F3		9	-	-	-	-	-	-	-	-
Begane grond G		21	-	-	-	-	-	-	-	-
Begane grond H		5	-	-	-	-	-	-	-	-
Begane grond I		15	-	-	-	-	-	-	-	-
Begane grond J		53	-	-	-	-	-	-	-	-
Begane grond L1		15	-	-	-	-	-	-	-	-
Begane grond L2		12	-	-	-	-	-	-	-	-
Gang noord 1e		-	-	-	-	-	-	-	-	-
Gang oost bg		-	-	-	-	-	-	-	-	-
Gang west1 1e		-	2	-	-	-	-	-	-	-
Gang west1 bg		-	-	-	-	-	-	-	-	-
Gang west2 1e		-	-	-	-	-	-	-	-	-
Gang west2 bg		-	-	-	-	-	-	-	-	-
Gang west3 bg		-	-	-	-	-	-	-	-	-
Gang1 midden bg		-	-	-	-	-	-	-	-	-
Gang2 midden bg		-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Gang west2 bg

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.D	4	-	-	-	-	-	-	-	-	-
1e verd.E	75	-	-	-	-	-	-	-	-	-
1e verd.F	33	1	-	-	-	-	-	-	-	-
1e verd.G	-	-	-	-	-	-	-	-	-	-
Begane grond A	7	-	-	-	-	-	-	-	-	-
Begane grond B	7	-	-	-	-	-	-	-	-	-
Begane grond C	7	-	-	-	-	-	-	-	-	-
Begane grond E	9	-	-	-	-	-	-	-	-	-
Begane grond F1	3	-	-	-	-	-	-	-	-	-
Begane grond F2	3	-	-	-	-	-	-	-	-	-
Begane grond F3	9	-	-	-	-	-	-	-	-	-
Begane grond G	21	-	-	-	-	-	-	-	-	-
Begane grond H	5	-	-	-	-	-	-	-	-	-
Begane grond I	15	-	-	-	-	-	-	-	-	-
Begane grond J	53	-	-	-	-	-	-	-	-	-
Begane grond L1	15	3	-	-	-	-	-	-	-	-
Begane grond L2	12	-	-	-	-	-	-	-	-	-
Gang oost bg	-	-	-	-	-	-	-	-	-	-
Gang west1 1e	-	2	-	-	-	-	-	-	-	-
Gang west1 bg	-	-	-	-	-	-	-	-	-	-
Gang west2 1e	-	-	-	-	-	-	-	-	-	-
Gang west2 bg	-	-	-	-	-	-	-	-	-	-
Gang west3 bg	-	-	-	-	-	-	-	-	-	-
Gang1 midden bg	-	-	-	-	-	-	-	-	-	-
Gang2 midden bg	-	-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Gang west3 bg

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.D	4	-	-	-	-	-	-	-	-	-
1e verd.E	75	-	-	-	-	-	-	-	-	-
1e verd.F	33	1	-	-	-	-	-	-	-	-
1e verd.G	-	-	-	-	-	-	-	-	-	-
Begane grond A	7	-	-	-	-	-	-	-	-	-
Begane grond B	7	-	-	-	-	-	-	-	-	-
Begane grond C	7	-	-	-	-	-	-	-	-	-
Begane grond E	9	-	-	-	-	-	-	-	-	-
Begane grond F1	3	-	-	-	-	-	-	-	-	-
Begane grond F2	3	-	-	-	-	-	-	-	-	-
Begane grond F3	9	-	-	-	-	-	-	-	-	-
Begane grond G	21	-	-	-	-	-	-	-	-	-
Begane grond H	5	-	-	-	-	-	-	-	-	-
Begane grond I	15	-	-	-	-	-	-	-	-	-
Begane grond J	53	-	-	-	-	-	-	-	-	-
Begane grond L1	15	3	-	-	-	-	-	-	-	-
Begane grond L2	12	-	-	-	-	-	-	-	-	-
Gang oost bg	-	-	-	-	-	-	-	-	-	-
Gang west1 1e	-	2	-	-	-	-	-	-	-	-
Gang west1 bg	-	-	-	-	-	-	-	-	-	-
Gang west2 1e	-	-	-	-	-	-	-	-	-	-
Gang west2 bg	-	-	-	-	-	-	-	-	-	-
Gang west3 bg	-	-	-	-	-	-	-	-	-	-
Gang1 midden bg	-	-	-	-	-	-	-	-	-	-
Gang2 midden bg	-	-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone

SCENARIO: Brand in gebied Gang1 midden bg

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.D	4	-	-	-	-	-	-	-	-	-
1e verd.E	75	-	-	-	-	-	-	-	-	-
1e verd.F	33	1	-	-	-	-	-	-	-	-
1e verd.G	-	-	-	-	-	-	-	-	-	-
Begane grond A	7	-	-	-	-	-	-	-	-	-
Begane grond B	7	-	-	-	-	-	-	-	-	-
Begane grond C	7	-	-	-	-	-	-	-	-	-
Begane grond E	9	-	-	-	-	-	-	-	-	-
Begane grond F1	3	-	-	-	-	-	-	-	-	-
Begane grond F2	3	-	-	-	-	-	-	-	-	-
Begane grond F3	9	-	-	-	-	-	-	-	-	-
Begane grond G	21	-	-	-	-	-	-	-	-	-
Begane grond H	5	-	-	-	-	-	-	-	-	-
Begane grond I	15	-	-	-	-	-	-	-	-	-
Begane grond J	53	-	-	-	-	-	-	-	-	-
Begane grond L1	15	-	-	-	-	-	-	-	-	-
Begane grond L2	12	-	-	-	-	-	-	-	-	-
Gang oost bg	-	-	-	-	-	-	-	-	-	-
Gang west1 1e	-	2	-	-	-	-	-	-	-	-
Gang west1 bg	-	-	-	-	-	-	-	-	-	-
Gang west2 1e	-	-	-	-	-	-	-	-	-	-
Gang west2 bg	-	-	-	-	-	-	-	-	-	-
Gang west3 bg	-	-	-	-	-	-	-	-	-	-
Gang1 midden bg	-	-	-	-	-	-	-	-	-	-
Gang2 midden bg	-	-	-	-	-	-	-	-	-	-

Overzicht personen aantallen per gebied in de bedreigde zone


SCENARIO: Brand in gebied Gang2 midden bg

Gebied (bedreigd)	Tijd[min]:	0	0.5	1	1.5	2	2.5	3	3.5	6
1e verd.D	4	-	-	-	-	-	-	-	-	-
1e verd.E	75	-	-	-	-	-	-	-	-	-
1e verd.F	33	1	-	-	-	-	-	-	-	-
1e verd.G	-	-	-	-	-	-	-	-	-	-
Begane grond A	7	-	-	-	-	-	-	-	-	-
Begane grond B	7	-	-	-	-	-	-	-	-	-
Begane grond C	7	-	-	-	-	-	-	-	-	-
Begane grond E	9	-	-	-	-	-	-	-	-	-
Begane grond F1	3	-	-	-	-	-	-	-	-	-
Begane grond F2	3	-	-	-	-	-	-	-	-	-
Begane grond F3	9	-	-	-	-	-	-	-	-	-
Begane grond G	21	-	-	-	-	-	-	-	-	-
Begane grond H	5	-	-	-	-	-	-	-	-	-
Begane grond I	15	-	-	-	-	-	-	-	-	-
Begane grond J	53	-	-	-	-	-	-	-	-	-
Begane grond L1	15	4	-	-	-	-	-	-	-	-
Begane grond L2	12	11	-	-	-	-	-	-	-	-
Gang oost bg	-	-	-	-	-	-	-	-	-	-
Gang west1 1e	-	2	-	-	-	-	-	-	-	-
Gang west1 bg	-	-	-	-	-	-	-	-	-	-
Gang west2 1e	-	-	-	-	-	-	-	-	-	-
Gang west2 bg	-	-	-	-	-	-	-	-	-	-
Gang west3 bg	-	-	-	-	-	-	-	-	-	-
Gang1 midden bg	-	-	-	-	-	-	-	-	-	-
Gang2 midden bg	-	-	-	-	-	-	-	-	-	-



Bijlage

2 BMS-ENG-DS-2005 versie 6 Oktober 2017

 Bristol-Myers Squibb Company	AUXILIARY SYSTEMS	Global Engineering Design Standard
Version: 6		BMS-ENG-DS-2005
Date: October 2017		



BMS-ENG-DS-2005

DESIGN STANDARD FOR AUXILIARY SYSTEMS

Approvals

Author:	Signature	Date
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1.0 Purpose

1.1 The purpose of Engineering Design Standards (DS) program is:

- 1.1.1 To create prescriptive design standards for use by the Engineering community to respond to projects more quickly and efficiently with minimal investment in the development of design direction.
- 1.1.2 To drive common engineering design criteria across the company while incorporating flexibility where necessary.


2.0 SCOPE

- 2.1 This Design Standard is applicable for new and renovated facilities to promote consistency in designs across BMS facilities.
- 2.2 This Design Standard must be used by architects and engineers involved in new facility construction and major renovations for all facilities occupied by BMS, regardless of the owner of the building.
- 2.3 The Design Standard requirements are generally accepted within the industry as proven; however, as with any design, new materials and technology must be evaluated as they become available. Any exceptions from this Design Standard must be documented and submitted as part of a Design Standard Waiver Form (BMS-ENG-FRM-105) and approved by the governing EHS and Engineering Personnel.
- 2.4 Where local laws, codes, or regulations require specific design practices which are in conflict with this Standard, local laws, codes or regulations must prevail.


3.0 OVERVIEW

3.1 Introduction

- 3.1.1 This Standard provides design considerations of Electrical Auxiliary Systems, which covers overall design approach and companion system operations. The design criteria includes construction data for Data center room and buildings. The primary objective of this Standard is to:
 - 3.1.1.1 Develop Electrical Auxiliary Systems that are reliable and meet the project needs.
 - 3.1.1.2 Provide cost effective and energy efficient systems.
 - 3.1.1.3 Assure continued regulatory compliance for the Electrical Auxiliary Systems, as applicable.
 - 3.1.1.4 Provide technology that is appropriate and maintainable.
- 3.1.2 The codes and standards described below are based on North American designs, equipment and generally accepted construction standards. Non North American designs, developments and construction standard must be adhered to local rules and regulations of those other locations.

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- 3.1.3 There are a number of standards for the installation, construction and performance of equipment published by organizations within and outside the United States, but by worldwide accepted conventions, local laws and regulations govern.
- 3.1.4 The systems and/or equipment included in this document shall be considered standardized US material and shall be used in all installations, unless otherwise permitted. The use of material other than those which have been specified, will only be accepted in markets outside North America, in cases where they are out readily available. Any substituted material (outside North America) shall comply with the following requirements:
 - 3.1.4.1 Meet or exceed all performance requirements.
 - 3.1.4.2 Provide equal to or greater warranty coverage (length of time, performance guaranties, application ensures).
- 3.1.5 The systems described are generally accepted within the industry as proven; however, as with any system design, new materials and technology must be evaluated as they become available. Any exceptions from this DS must be reviewed with EHS and Engineering Personnel. Changes to the DS must be reviewed and approved via a documented change management process
- 3.1.6 There are many types of different facilities for which Electrical Auxiliary systems will be required, each with their own requirements, but design philosophies remain the same. The following are key design steps required during the design:
 - 3.1.6.1 To define the type of facility and the operational requirements of each area within the facility.
 - 3.1.6.2 To develop a set of Electrical Auxiliary systems that meets the design criteria with an appropriate balance of cost and risk.
 - 3.1.6.3 To provide a means to control the systems so that design criteria is met.
 - 3.1.6.4 To assure that the systems meet the design criteria.
- 3.1.7 System design must begin with a definition of systems required, which becomes the basis of all system components. All criteria must be established based on the space type and the critical parameters for that space. Facility locations, as well as GMP requirements, are key elements in determining system and components.
- 3.2 Quality Consideration
 - 3.2.1 Certain parts of some facilities may be subject to regulatory compliance. It is imperative that Electrical Auxiliary systems that affect regulated operations

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are designed to an end result that repeatedly meets the requirements of the regulatory body.

- 3.2.2 From the regulatory standpoint, the objective of the controlled environment is to protect the integrity of the exposed product.

4.0 SYSTEM DESIGN BASIS

4.1 Command Center

4.1.1 System Overview


- 4.1.1.1 Must accommodate at least 2 Administrative-type workstations, and 2 rooms with doors, full length walls (Console; conf rm).
- 4.1.1.2 Card Access (Commend type Device) on security suite entry doors with restricted access.
- 4.1.1.3 Telephone recording system

4.1.2 Security Console Station must be equipped with the minimum requirements:

- 4.1.2.1 4 monitors (CCTV; TV/Cable Feed; ACS, etc.) (Min 22")
- 4.1.2.2 2 PC Workstations (as per BMS Standards)
- 4.1.2.3 2 Telephones & 1 POTS line
- 4.1.2.4 Appropriate software (Milestone; cCure) to operate systems

4.1.3 Security Crisis/Conference Room

- 4.1.3.1 This will be a Type B Standard design type, Presentation and Audio Conference Room. This is small conference space that seats 11 people.
- 4.1.3.2 At least two of the walls must have sound absorption material installed from floor to ceiling.
- 4.1.3.3 Acoustical ceiling tiles must be utilized instead of any multi-level ceiling designs. No solid ceiling or multi-level ceiling should be installed in this space as they create echo.
- 4.1.3.4 LED lighting should be used throughout the space for an even lighting experience and the floors should be carpeted. Spot lighting can only be utilized to light the perimeter walls except on the screen wall.
- 4.1.3.5 Any and all exterior facing windows must have 90% light blocking draperies or shades that also have acoustical properties to stop echo from bouncing off the glass surface. Any and all interior glass walls must be frosted for privacy.

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4.1.3.6 AV Requirements

- 4.1.3.6.1 Two NEC LED displays will be wall mounted. One will be a large 80 inch display for content and the other will be a 50 inch series for Cable TV feed.
- 4.1.3.6.2 The system will be controlled via the Extron 7" Cable Cubby Touchlink Touch Panel.
- 4.1.3.6.3 The table interface will support the following; power, LAN, Appropriate PC interfaces.
- 4.1.3.6.4 Audio will be handled via a polycom table top device plus one (1) POTS lines.
- 4.1.3.6.5 FIOS TV is a requirement for this space
- 4.1.3.6.6 Crestron Room Scheduler


4.2 Fire Alarm

4.2.1 System Overview

- 4.2.1.1 The fire alarm system shall comply with all applicable regulatory requirements and be compliant with NFPA Standard No. 72 for Local Protected Premises Signaling Systems). The fire alarm system shall be designed and manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994, (or its equivalent).
- 4.2.1.2 All Fire Alarm systems must report to a main command center.
- 4.2.1.3 The fire alarm system must be addressable type. The system must be provided with audible and visual.
- 4.2.1.4 North America Designs for new or significantly modified FA systems shall be reviewed in advance of installation by FM Global; European designs shall be reviewed by applicable organization.
- 4.2.1.5 The fire alarm system shall be designed and shall consist of a microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete, operative, coordinated system.
- 4.2.1.6 All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a fire protective signaling system, meeting the National Fire Alarm Code.


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- 4.2.1.7 To the extent feasible, all fire alarm equipment and components shall be FM Approved and shall be of independent 3rd party approved, such as FM, UL cUL, etc.
- 4.2.1.8 Voice evacuation systems is required. For campus or multiple building environments, the voice evacuation system must be capable of remote broadcasting of announcements for Mass Evacuations and specialized needs.
- 4.2.1.9 System must consist of addressable devices interconnected through intelligent loops. All of the devices must communicate to a centralized monitoring location with graphic display. The loops must be configured in accordance with local BMS EHS team.
- 4.2.1.10 System must provide for 25% spare capacity for future expansion of alarm points and interlock systems.
- 4.2.1.11 Fire alarm and signals services must be extended from the nearest applicable system loop (initiating or indicating) - within the building. Where capacity of the existing applicable loop is not adequate, new applicable loop and required components shall be included.
- 4.2.1.12 Fire alarm wiring system must be designed to meet or exceed the site and corporate specifications and technical requirements. Wiring must be of designated type and/or be listed and labeled to conform to fire alarm wiring, as defined by applicable codes and/or regulations.
- 4.2.1.13 All fire alarm wiring must be run in raceway: dedicated cable tray or conduit and boxes, as required by applicable safety rules and regulations or local fire code. Raceway system must be color marked for identification as per Identification Color Code included in these standards.
- 4.2.1.14 Fire alarm equipment and devices must be provided at corridors, offices, laboratories, mechanical areas and process rooms, and locations as required by applicable safety rules and regulations. Smoke detection systems shall be provided in any area that is not normally occupied such as mechanical rooms, electrical room, and interstitial spaces.
- 4.2.1.15 System must consist of control panel, annunciator, initiating devices (pull stations, smoke detectors, heat detectors, etc.) and indicating devices (horns, strobes, speakers, loudspeakers, etc), where applicable. A weather appropriate audio/visual


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indicating device must be located outdoors on the building exterior and/or roof.


- 4.2.1.16 All new cabling, system, faceplates and associated equipment must be manufactured by the same company. New equipment and hardware must match the existing to the possible extent.
- 4.2.1.17 The fire alarm System must be capable of communication with the Building Automation System (BAS). Contact output or communication interface must be used.
- 4.2.1.18 The fire alarm control panel should include a Remote actuation and shutdown key to control the HVAC in the event of a fire
- 4.2.1.19 All duct smoke detector shutdown capabilities must be hard wired to the HVAC controlling equipment through NO-NC dry contacts provided. Communication with the BAS system must be provided through control module interface.
- 4.2.1.20 When multiple fans have to be interconnected through the same duct smoke detector, external relay(s) with adequate number of appropriate dry contacts must be added to the system.
- 4.2.1.21 Connection between the building fire alarm panel and the supervised remote monitoring annunciator panel must be provided by means of fiber optic and/or Ethernet and/or phone cable, Class A wiring architecture (closed loop). If fiber optic cable is provided, all necessary interfacing equipment must also be provided.
- 4.2.1.22 All equipment to be installed on electrically classified hazardous locations must be labeled and approved for such installation.
- 4.2.2 Equipment (as requirements from applicable safety rules and regulations)
 - 4.2.2.1 All components shall be Factory Mutual approved Simplex, Honeywell, and EST or approved equal to match existing plant equipment.
 - 4.2.2.2 Addressable Type Main Control Panel:
 - 4.2.2.2.1 Type: Modular construction, including: Power supply panels; supervised signal circuit panels, remote station panel, fireman's override key to start HVAC fans for smoke evacuation, low battery voltage alarm panel; all housed in one enclosure. System shall be fully compatible with site fire alarm/security system.

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- 4.2.2.2.2 Mounting: As indicated on the drawings.
- 4.2.2.3 Automatic Charger and Battery Cabinet: (Part of main Control Panel unless otherwise indicated)
 - 4.2.2.3.1 Type: Ventilated cabinet with steel divider separating battery from automatic charger control.
 - 4.2.2.3.2 Controls: Automatic charger, which monitors the voltage condition of the batteries, with meter on door; adjustable trickle-rate, controlled by switch, with meter on door; manual override switch for automatic feature.
 - 4.2.2.3.3 Finish: Prime coat, finished red enamel.
 - 4.2.2.3.4 Mounting: Surface.
- 4.2.2.4 Standby Batteries:
 - 4.2.2.4.1 Type: Sealed lead acid plastic containers; long life, low maintenance.
 - 4.2.2.4.2 Capacity: As required by Factory Mutual but not less than 24 hour standby power followed by 5 minutes in alarm.
- 4.2.2.5 Manual Alarm Station: Addressable Type
 - 4.2.2.5.1 Type: Pull handle operation. STI covers shall be provided for all the pull stations in Child Development Centers, for those pull stations located in high traffic areas such as lobbies and atriums and as required by local ordinance.
 - 4.2.2.5.2 Contacts: Normally open; close to actuate alarm.
 - 4.2.2.5.3 Identification and Instruction: Raised lettering cast integral with face plate "FIRE ALARM"; "PULL DOWN" engraved on handle.
 - 4.2.2.5.4 Finish: Lexan red housing and white lettering.
 - 4.2.2.5.5 Box: As required by equipment manufacturer.
 - 4.2.2.5.6 Mounting: One (1) flush box; height forty-eight inches (48") above finished floor.
 - 4.2.2.5.7 Key Lock: For test and reset; shall be keyed alike with fire alarm cabinet.

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- 4.2.2.5.8 For explosion hazard areas, provide equipment suitable for Class 1, Division 1, Group C and D per National Electric Code (NEC) or equivalent.
- 4.2.2.5.9 Provide NEMA 4 construction or weather protection hood for outdoor applications.
- 4.2.2.6 Automatic Thermal Detectors: Addressable Type
 - 4.2.2.6.1 Types:
 - Rate-of-rise combination rated for 135°F (57°C).
 - Fixed temperature rated for 195°F (90°C).
 - 4.2.2.6.2 Contacts: Normally open.
 - 4.2.2.6.3 Finish: White.
 - 4.2.2.6.4 Mounting: Surface, low silhouette.
 - 4.2.2.6.5 Loose Equipment: Provide two (2) spare units of each type used.
 - 4.2.2.6.6 For explosion hazard areas, provide equipment suitable for Class 1, Division 1, Group C and D per National Electric Code (NEC) or equivalent.
 - 4.2.2.6.7 For operation below 32°F (0°C) provide four (4) wire Class "A" hard wiring or locate addressable interface module in a heated area.
- 4.2.2.7 Automatic Smoke Detectors - Addressable Type
 - 4.2.2.7.1 Ceiling flush or surface mounted detector as indicated on drawings.
 - Type: Photoelectric with built in tester.
 - Detection Response: Nominal one and half percent (1.5%) light obscuration per foot.
 - Thermal Device Rating: One hundred thirty-five (135) degrees F.
 - Relay: Provide as required with one (1) normally open and one (1) normally closed auxiliary contact.
 - For explosion hazard areas, provide equipment suitable for Class 1, Division 1,

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Group C and D per National Electric Code (NEC) or equivalent.


- Smoke detectors shall be provided in all areas that are not normally occupied such as mechanical rooms, electrical room and interstitial

4.2.2.7.2 Ceiling flush or surface mounted detector as indicated - Addressable Type

- Type ionization with two (2) chambers containing no moving parts, fully adjustable with sensitivity test set.
- Solid state, 22 volt direct-current (DC) operating voltage, with lamp to indicate an alarm.
- Relay: Provide as required with one (1) normally open and one (1) normally closed auxiliary contact.
- For explosion hazard areas, provide equipment suitable for Class 1, Division 1, Group C and D per National Electric Code (NEC) or equivalent.

4.2.2.7.3 Duct type detector - Addressable Type

- Type: Ionization.
- Detection: Factory set to detect both visible and invisible particles of combustion at two percent (2%) obscuration per foot level.
- Reset: At control panel.
- Relay: Provide as required with one (1) normally open and one (1) normally closed auxiliary contact.
- Provide a remote indication light directly below each duct detector and mounted on the underside of the ceiling where the detector is concealed.
- Duct detectors shall be re-settable from the fire alarm panel.
- For explosion hazard areas, provide


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equipment suitable for Class 1, Division 1, Group C and D per National Electric Code (NEC) or equivalent.

4.2.2.7.4

Automatic Long Range Beam Smoke Detector

- Type: Long range beam type consisting of a separate transmitter and receiver.
- Description: The transmitter emits an invisible pulsed infrared beam to the receiver. If the beam is obscured beyond the selected threshold by smoke, the receiver signals an alarm. If the beam is completely blocked, the receiver signals a trouble condition.
- Coverage: 30 to 500 feet, up to 60 foot spacing on smooth, flat ceilings.
- Signal Processing: Automatic Signal Synchronization eliminates the need for synchronization wire. Self compensating circuitry compensates for signal loss due to dust or dirt build-up on lens and signals a trouble condition upon signal loss of 50%.
- Mounting: Surface or ceiling mount to standard 4" square or octagonal electrical boxes.
- Alarm Output: Form B (C, NO) contacts rated 1 Amp, 60 VDC maximum for resistive loads. Form C (NC, C, NO) auxiliary alarm contacts rated 1 Amp, 60 VDC maximum for resistive loads.
- Tamper Output: Form A (C, NC) contacts rated 1 Amp, 60 VDC maximum for resistive loads.
- Test Feature: Externally visible LEDs on Transmitter and Receiver give indication of signal alarm, and supervision conditions. Remote display plate allows for remote testing and reset, and gives remote output of Receiver LEDs and signal voltage.
- Radio Frequency Immunity: No alarm or set

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up on critical frequencies in the range from / to 950 Megahertz using a 50 watt transmitter.

- Make: Bosch, Model DS240 and DS241 with remote test / indicator plate or approved equal.


4.2.2.7.5 High Sensitivity Smoke Detector

- Type: Laser based.
- Description: Smoke detector shall detect highly diluted smoke concentrations as low as 0.0015% obscuration per foot. The sensitivities enables detector to detect low energy fires, in high airflow environments that tend to dilute the smoke concentration. The fan draws air from the protected area through the sampling pipe network to the detector. The display control card receives and processes the information from the detector. It graphically displays the smoke level and reports all alarms and system trouble conditions. Three levels of alarm to be provided. Each alarm threshold level to be programmed.
- Alarm Output: Four sets for form C contacts. One set for each alarm level and one set for trouble conditions.
- Piping Network: The air sampling pipe network shall extend into the protected area or air duct and contains strategically placed holes to draw samples of air. The air sampling pipe shall be PVC or metal smooth bore pipe with 1", 3/4", or 1/2" internal diameter. The air sampling pipe network shall be computer balanced.
- Make: Fenwal Analaser, Vesda Aspire or approved equal.

4.2.2.8 Strobes/Horns/Speakers:

4.2.2.8.1 cGMP general purpose clean process areas:

- Horns/Speakers shall be UL approved, flush,

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ceiling mounted with recessed outlet box, clean, smooth finish similar to Arnscoff electronics group make AS 4000 model with G75SS clean room baffle cover or approved equal.


- Strobes shall be UL approved, wall mounted with smooth front finish similar to Honeywell model XLS 405 or approved equivalent. Strobe surface contact between the strobe and wall shall be caulked for smooth finish.

4.2.2.8.2 Hazardous cGMP/clean room process areas:

- Horns/Speakers shall be UL approved explosion proof type with appropriate hazardous classification and installed over flanged backer plate. The clean cover shall be visible into the process room. Sound transmitting baffle with clean cover shall be washable, chemical resistant with flush mounted stainless steel baffle similar to Arnscoff electronics group model G75SSW. The horn/speaker shall be located close to a light fixture or any other accessible location for maintenance access. Horn/Speaker enclosure shall be installed to prevent air infiltration.
- Strobe shall be UL approved, explosion proof type with appropriate hazardous classification and installed semi flush with high impact glass dome removable below the ceiling for maintenance. The strobe shall be located close to a light fixture or any other accessible location for maintenance access. The gap between the ceiling and the lens shall be sealed with appropriate caulk to prevent air infiltration.

4.2.2.8.3 Hazardous process areas:

- Horns/Speakers shall be UL approved explosion proof of appropriate hazardous classification, wall/ceiling mounted type.

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- Strobes shall be UL approved, explosion proof of appropriate hazardous classification, wall/ceiling mounted type.

4.2.2.8.4 General purpose laboratory/process areas:

- Horns/Speakers shall be UL approved, general purpose, combination type, flush mounted with recessed outlet box.
- Strobes shall be a dual strobe expander plate for both fire (clear) and BAS (blue) alarms. UL 1971 listed ADA compliant clear lens light source, plus UL 1638 listed blue lens strobe.

4.2.2.8.5 General purpose out door and mechanical areas:

- Horns/Speakers shall be UL approved, weather proof, wall mounted, and high level audio output amplified speaker type suitable for high noise environment.
- Strobe shall be UL approved, weather proof, wall mounted type.

4.2.2.9 Strobe/Horn Type:

4.2.2.9.1 Heavy-duty modular horn or solid state Piezo horn and high intensity strobe to meet ADA requirements.

4.2.2.9.2 Decibel Rating: One hundred four (104) dBA at ten (10) feet in process and mechanical areas, 90 dBA at 10 ft. in non-process areas.


4.2.2.9.3 Mounting: Flush, in recessed outlet box; one (1) foot below ceiling unless otherwise shown.

4.2.2.9.4 Finish: Red.


4.2.2.9.5 For explosion hazard areas, provide equipment suitable for Class (I/II), Division (I/II), Group (A/B/C/ D/E/F/G) as per National Electric Code (NEC) and as specified on the drawings with appropriate hazardous classification marking.

4.2.2.9.6 Provide NEMA 4 construction or weather protection hood for outdoor applications.

4.2.2.10 Initiation and Signal Devices

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- 4.2.2.10.1 Initiation devices and signal devices located in general purpose/hazardous areas shall be of approved design and classifications as shown on the Drawings. All devices in hazardous areas shall be approved and installed in strict accordance with Article 500 of the NEC and as shown on Drawings.
- 4.2.2.11 Annunciators: (Part of main control panel unless otherwise indicated)
 - 4.2.2.11.1 Function: Visual indication of fire location or sprinkler system valves by indicator lamp or retrievable LCD message.
 - 4.2.2.11.2 Construction: Back lighted annunciator with separate film positive designation nameplate; letter height one-eighth (1/8) inch.
 - 4.2.2.11.3 Mounting as shown on drawings.
 - 4.2.2.11.4 Auxiliary panels as noted on plans.
- 4.2.2.12 Control Modules:
 - 4.2.2.12.1 Intelligent, addressable with form C contacts, electronically coded serial number, automatic device mapping and self diagnostic type with red and green LED.
- 4.2.2.13 Monitor Modules:
 - 4.2.2.13.1 Intelligent, addressable single /multi input modules, electronically coded serial number, automatic device mapping and self diagnostic type with red and green LED.
- 4.2.2.14 Loose Equipment:
 - 4.2.2.14.1 Furnish ten (10) keys for manual alarm stations.
 - 4.2.2.14.2 Furnish two (2) spare thermal detectors for each type used.
 - 4.2.2.14.3 All loose equipment shall be delivered to the Owner.
 - 4.2.2.14.4 Provide required interface components where applicable to match existing fire alarm system.

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4.2.2.15 Quality Assurance


- 4.2.2.15.1 The equipment manufacturer and electrical contractor shall have local offices, staffed by factory trained engineers and technicians fully capable of providing re-assembly, testing, instruction, maintenance, and emergency service on all system components.
- 4.2.2.15.2 As a condition of acceptance prior to bidding, the equipment supplier and the electrical contractor shall demonstrate a minimum 5 years experience in the successful design and installation of multiplexed fire alarm systems similar in size and scope to that required.
- 4.2.2.15.3 Conform to all UL standards for testing and provide certification of the installation by a UL approved testing company.

4.2.3 Automatic fire detection system shall be provided in electrical distribution rooms, control rooms and/or security centers. Electrical distribution rooms shall be provided with a 2 hour rated fire wall to avoid the requirement of installation of fire suppression systems.

4.2.4 Where magnetic locks are used on doors that are to be kept secured for the use of authorized personnel only, they must be installed to meet applicable safety rules and regulations included in Life Safety codes. Refer to BMS-OCD-3kS4 Occupational Health and Safety Standards Manual Life Safety Chapter . Doors locks should fail open upon activation of FA signal. On magnetic locks, an addressable FA control module shall be used to cut-off power service to the magnetic lock for its release on a fire alarm / condition. These conditions and requirements are applicable to all routes and controlled access areas such as transitional spaces, manufacturing areas and security doors.

4.2.5 Highlights Of EHS Life Safety Directive On Magnetic Locks

- 4.2.5.1 Refer to BMS-OCD-3kS4 Occupational Health and Safety Standards Manual Life Safety Chapter .
- 4.2.5.2 Refer to Local / State building codes
- 4.2.5.3 Refer to International Building Code Section 1008.1.3.4 Access Controlled Doors
- 4.2.5.4 Whenever any primary exit doors or exit access doors are equipped with access control security devices such as magnetic locks, all of the following criteria must be met:

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4.2.5.4.1 The doors must be equipped with a manual release device that is located 40 inches to 48 inches (102 to 122 centimeters) vertically above the floor and within 5 feet (1.5 meters) of the secured doors, on the same side of the normal egress swing to open, opposite the hinge (i.e. place on the right side for a doors that swings open to the left). The release device must be clearly labeled with a sign that reads "PUSH TO EXIT". The sign must be in the language of the country in which the facility is located. The release device must result in direct power interruption to the magnetic locks, independent of system electronics. The operation of the release device must be arranged so that it is immediately obvious and requires no special knowledge to operate. A sensor shall be provided on the egress side to detect an occupant approaching the door.

4.2.5.4.2 The security devices must be designed to automatically de-energize and release the door in the event of a building fire alarm remaining unlocked until the alarm is reset.

4.2.5.4.3 For purpose of maintaining a secure building during occasional power failures, BMS may choose to maintain magnetic locks in a secure position during the outage. However, careful design that assures life safety egress is paramount. Therefore, if release devices do not automatically release the doors upon loss of power supply to the facility, the release system must be equipped with an emergency power supply that maintains the PUSH TO EXIT system and the design must further assure release of the doors in the event of a power failure of the auxiliary power supply.

4.2.6 Identification Color Code


4.2.6.1 Junction and pull boxes must be marked with color codification to facilitate installation, inspection, record and troubleshooting: RED.

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4.3 Electronic Security System


4.3.1 System Description

- 4.3.1.1 Overall, the “System” can be defined as an integrated system, combining intrusion protection, card access, and photo identification badges, closed circuit television and intercom/audio systems. These systems shall be designed to work in conjunction with each other, and where applicable, an “alarm” condition shall prompt alarm monitoring, notification (both internal and, if necessary, to a third-party facility) and dedicated Closed Circuit Television (CCTV) monitoring and recording.
- 4.3.1.2 All Security system must report to a main command center.
- 4.3.1.3 Risk assessment shall be completed prior to final design by Corporate Security Dept. to determine the placement and requirement of security devices. Location of cameras, card readers and alarms must be denoted on the plans.
- 4.3.1.4 System must consist of card access, intercom, CCTV and/or building intrusion devices, as applicable.
- 4.3.1.5 CCTV control system must be distributed by means of copper conductors.
- 4.3.1.6 CCTV video system must be distributed by means of fiber optic and/or copper conductors.
- 4.3.1.7 System must provide for 25% future capacity expansion for alarm points and interlock functions.
- 4.3.1.8 Security service must be extended from the nearest source.
- 4.3.1.9 Secured areas hardware locks must be compatible to plant wide locking system.
- 4.3.1.10 Single and multi-mode fibers must be used for data transmission.
- 4.3.1.11 Where required, security and Controlled Access equipment and devices must be provided at building entrances, emergency egress and operational doors that are to be kept secured for the use of authorized personnel only. System must consist of card access, intercom, CCTV and/or building intrusion devices, as applicable. Where magnetic locks are used, they must be installed to meet applicable safety rules and regulations of applicable Life Safety codes. On magnetic locks, an addressable

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FA control module shall be used to cut-off power service to the magnetic lock for its release on a fire alarm / condition.

- 4.3.1.12 Doors locks should fail open upon activation of FA signal.
- 4.3.1.13 Security cabling system must be designed to meet or exceed the site and corporate specifications and technical requirements.
- 4.3.1.14 All new cabling, system, faceplates, jacks, patch panels, and associated equipment must be manufactured by the same company. New equipment and hardware must match the existing to the extent possible.
- 4.3.1.15 All new cabling, system, faceplates, jacks, patch panels, and associated equipment must fall under a manufacturer solution that provides 40 yr Limited Lifetime warranty (example: Berk-Tek's/Leviton Solution or Superior Essex's (nCompass) Solution. New equipment and hardware must match the existing to the extent possible.
- 4.3.1.16 All cabling must be run in raceway: cable trays or conduit and boxes, as directed. Raceway system must be color marked for identification as per Identification Color Code included in these standards.
- 4.3.1.17 Where new voice / data outlets are required, new conduits (with pull strings) between the outlet location and the cable tray or communications closet must be provided.
- 4.3.1.18 When cable trays are provided, all cables must be UL-listed CMP for placement in an air-handling plenum environment.
- 4.3.1.19 All equipment to be installed on electrically classified hazardous locations must be labeled and approved for such installation.
- 4.3.1.20 The following security equipment must be provided in accordance with an "asset protection survey" coordinated with Corporate Security:
 - 4.3.1.20.1 Magnetic Locks
 - 4.3.1.20.2 Electric Strike
 - 4.3.1.20.3 Power Transfer Hinge
 - 4.3.1.20.4 CCTV cameras
 - 4.3.1.20.5 CCTV central control equipment
 - 4.3.1.20.6 Monitors

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4.3.1.20.7 Event recorders

4.3.1.20.8 Zoom-Pan-Tilt control

4.3.2 Base System

4.3.2.1 The base of this "System" shall be a Microsoft Windows server based card access system, capable of handling data collection, card access, security point monitoring, photo identification badges and point control. The system shall consist of a central processor, transaction media storage and a secondary "remote" terminal/Personal Computer. The software shall be configured to control and monitor all transactions of the system; valid/invalid transactions, alarm/reset conditions, card access authorization, alarm acknowledgement and audit trails. Additionally, the system software shall have the following capabilities; on-line editing, user defined complex control strategies (i.e. interlocking), prioritized event reporting, selective reporting of system activity, historical data collection, graphic status display and user definable report generation.

4.3.2.2 All intrusion alarms and card access controlled doors will be interfaced into the "system" central processor to provide for primary on-site monitoring by security personnel. The system shall provide for alarm outputs for each point specified, so they may be interfaced into the CCTV system to provide visual monitoring of alarm point areas, where applicable, and notification to the central station.


4.3.2.3 Standard of Acceptance: Software House: C-Cure 9000 Access Control. Alternative access control systems meeting the base BMS system standards above are permissible with approval of Corporate Security management.

4.3.3 Intelligent Controllers:

4.3.3.1 Provide new Intelligent Controllers where required on drawings. Provide the number of controllers necessary to provide all functions required for each card access and door monitoring location shown.

4.3.3.2 Provide sufficient controllers on each floor such that all devices shown on an individual floor may be connected without running conduit and wiring to units on adjacent floors.

4.3.3.3 Controllers shall include all input cards, mother boards, power supplies, output cards, relays and other components required

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to connect a full complement of card readers and associated devices to each controller.

- 4.3.3.4 Provide battery back-up and recharging capability for each controller provided such that all connected equipment (except power booster equipment) will operate for a period of six (6) hours.

4.3.4 Remote Reader Electronics

- 4.3.4.1 Provide at each card reader location a Remote Reader Electronics Module as shown.
- 4.3.4.2 Modules shall be complete, including enclosure and shall be designed for wall mounting.
- 4.3.4.3 Each remote reader enclosure shall include a tamper switch.

4.3.5 Magnetic Personnel Door Switches


- 4.3.5.1 Door status switches used on facility personnel doors shall be wide gap, concealed magnetic door switches.
- 4.3.5.2 The above switches shall be used on all facility personnel doors whether connected to a card reader related door or a non card reader monitored door.
- 4.3.5.3 Surface mounted switches shall be used only for renovation of existing doors, with Owner approval.

4.3.6 Request to Exit Motion Sensors

- 4.3.6.1 Provide motion sensors used as Request to Exit (REX) devices. Sensors shall be of the PIR type and shall be designed for ceiling and/or wall mounting.
- 4.3.6.2 Each sensor shall include an adjustable relay latch time and shall be internally pointable. Latch time shall be adjustable up to sixty (60) seconds.
- 4.3.6.3 Each sensor shall be designed to operate on twelve (12) or twenty-four (24) volts AC or DC and shall be configured to match the voltage provided by the ACU power supply.

4.3.7 Card Readers

- 4.3.7.1 The card reader portion of the system shall utilize HID multiclass proximity based cards. The readers must have the ability to use older existing HID card technology, deploy multi technology with the ability to transition to new contactless smart card technology. Each card reader shall be considered

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“intelligent” or wired to an intelligent controller and can therefore run independent of the central processor, with badge specific access authorization at the local level, not requiring the central processor.

4.3.7.2 Standard of Acceptance: HID RP40 Multiclass (varying sizes RP10/R10 and RP15/R15)

4.3.8 Biometric Readers

4.3.8.1 Highly restricted areas require multi-factor authentication and in those cases biometric readers will be used. Biometric readers will have the capability to do proximity card plus fingerprint or proximity card plus fingerprint and pin code. The readers will be capable of integration with the Software House solution.

4.3.8.2 FST Biometrics In Motion IDentification (IMID) technology identifies users at a distance and in motion using a unique fusion of biometric identification technology.

4.3.8.3 Standard of Acceptance: L-1 Identity Solutions- 4GV-Station; FST IMID

4.3.9 Electric Locking and Power Boosters

4.3.9.1 Electric locking devices, power boosters, request to exit (REX) devices on panic bar doors and electric hinges will be provided by the Finish Hardware Contractor.

4.3.9.2 Provide adequately sized output relays and power supplies to meet all electric lock requirements (except high current panic bar solenoids requiring power boosters).


4.3.10 Identification Color Code

4.3.10.1 Junction and pull boxes must be marked with color codification to facilitate installation, inspection, record and troubleshooting: BLUE.

4.3.11 ID Badges

4.3.11.1 HID BMS Corporate 1000 will be used at all BMS locations. Card formatting must be consistent and integrated with the approved corporate security access control program - CCure Software House. BMS is committed to a one card solution for all BMS sites.


4.3.11.2 Standard of Acceptance: HID iClass and standard prox chips shall be factory encoded with the same sequential 35-bit

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Corporate 1000 coding. HID shall use the next sequence of Corporate 1000 code numbers allocated to BMS.

4.3.12 Video Management Software - Closed Circuit Television

- 4.3.12.1 Only authorized personnel are permitted to install, record, or review any digital footage on all company sites. The Closed Circuit Television system shall be based upon a digital recording system, tied and configured to the company Local Area Network or a private security Local Area Network, to allow for viewing from authorized desktop workstations. The system shall be “open architecture” in that cameras from different manufactures can be used on the system so long as they meet the minimum resolution standard.
- 4.3.12.2 This system shall have the capability of being configured with multiple control locations. Cameras can automatically switched into tour of group sequences that are programmable through the system administrative console. In addition, events can be programmed to combine camera-monitor selections: providing for “alarm” call-up, tours, predefined spotting, and auto “home” reset. All Closed Circuit Television Cameras shall be recorded on a twenty-four a day basis or via motion detection. Video and/or data storage capability shall be for a minimum of 30 days.
- 4.3.12.3 All exterior CCTV units shall be enclosed in weatherproof and heated housings. The specific cameras specified by vendor shall be capable of low-light usage, either independently or through the use of supplied Infra-red lighting.
- 4.3.12.4 Minimum resolution on cameras both interior and exterior shall be IP with minimum of 1.4 megapixel resolution.
- 4.3.12.5 Recording Server: With 100+ camera applications, recording server(s) to be provided/configured by BMS/HP. Server size should be 1terabyte. With applications less than 100 cameras, the security integrator to provide a Milestone Husky server (M10; M20; M30;M50).
- 4.3.12.6 A complete (hardware and software) modular, scalable, microprocessor based Security Video Surveillance System (VSS) for the monitoring, recording, alarming and archival of security camera video within the site must be provided.
- 4.3.12.7 All equipment to be installed on classified hazardous locations must be labeled and approved for such installation.


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- 4.3.12.8 VSS must be designed for communications to a central location in the facilities. In addition, VSS must report to a centralized location external to the facilities.
- 4.3.12.9 All cabling must be run in raceway: cable trays or conduit and boxes, as directed. Raceway system must be color marked for identification as per Identification Color Code included in these standards.
- 4.3.12.10 Where new system outlets are required, new conduits (with pull strings) between the outlet location and the central system must be provided.
- 4.3.12.11 Equipment
 - 4.3.12.11.1 System Manager: A primary (and a backup) System Manager must be provided. System Managers to enable the centralized system configuration, management, and reporting of system databases, activities and events.
 - 4.3.12.11.2 Video Workstations: Workstations with full imaging display capability and configured to perform surveillance monitoring, alarm monitoring, maintenance, configuration and programming operations must be provided.
 - 4.3.12.11.3 Video Console Displays & Keyboards: Video Console Display Managers and Video Keyboard Controllers for comprehensive video surveillance including live monitoring, sequencing, touring, camera movement control, recording/archiving, archival review, and alarm/triggered views must be provided.
 - 4.3.12.11.4 Networked Digital Video Recorders: Network Digital Video Recorders to support evidentiary archiving of video from associated security cameras and providing access of stored video to other system components and software must be provided. Recorders must be configured to record video streams for a minimum of 30 days. After 30 days, stored video is to be downgraded (using the optimization function) to a minimum video quality, which must be kept for an additional 60 days but at a lower video quality to

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minimize storage requirements. Recorders must be able to manage video storage with external storage devices.

- 4.3.12.11.5 Video Encoders: Encoders capable of converting analog video streams to distributed digital data streams for viewing and recording must be provided.
- 4.3.12.11.6 Video Decoders: Decoders capable of converting distributed digital data streams to analog video streams for viewing must be provided.
- 4.3.12.11.7 Video Analytics System: A complete (hardware and software) modular, scalable, microprocessor based system for the analysis and alarming of the video content from the Video Surveillance System must be provided.
- 4.3.12.11.8 Data Networking Equipment. Networking hardware that meet or exceed the Video Surveillance System equipment design requirements must be provided.
- 4.3.12.11.9 Security Video Cameras. Closed Circuit Television cameras with complete setup for desired focal scene, focus/iris settings, and communications to not only provide power and video signal, but also alarm triggering and video analytics/motion detection interface must be provided.
- 4.3.12.11.10 Power Supplies for video cameras, compatible with the VSS equipment must be provided. Power supplies must be regulated, linear and isolated for the field panels and other equipment. All power supplies must be housed in tampered, locked enclosures.
- 4.3.12.11.11 Access Control Interface: Access Control System (ACS) interface (hardware, software, programming, etc.) for alarm event initiation on the VSS, for video stream viewing on the ACS, and for input/output triggering between both systems must be provided.

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4.3.12.12 Identification Color Code

4.3.12.12.1 Junction and pull boxes must be marked with color codification to facilitate installation, inspection, record and troubleshooting: BLUE.

4.3.12.13 Standard of Acceptance: Milestone, BMS currently owns a Milestone XProtect corporate license with the main global servers residing at the BMS Lawrenceville data room. A separate XProtect license resides with the BMS Redwood City location.

4.3.13 Fixed Cameras

4.3.13.1 Minimum resolution on cameras both interior and exterior shall be 1.4 megapixel. For darkened outdoor use, camera shall be color with low light capability. Video and control signals shall be transmitted from/to security central via IP whenever possible.

4.3.13.2 Standards of Acceptance: Axis P3364; Arecont; Omnivision; Arecont Minidome; Sharp

4.3.13.3 Note about capability with Milestone - Arecont and Axis are fully integrateable with the Milestone VMS platform.

4.3.14 PTZ Cameras

4.3.14.1 The minimum resolution of camera will be 1.4 megapixel. For darkened outdoor use, camera shall be color with low light capability. The current standard for perimeter CCTV monitoring is the Video and control signals shall be transmitted from/to security central via IP whenever possible.


4.3.14.2 Standard of Acceptance: Axis P5534-E; Sharp; etc.

4.3.15 Intrusion Detection System


4.3.15.1 The protected space shall be provided with a complete intrusion alarm system. Intrusion protection will be provided by way of door contact switches, and motion sensors. The intrusion alarm system is designed to detect unauthorized entry to protected spaces.

4.3.15.2 The security alarm system should be UL listed for Commercial Burglary and Commercial Fire (if applicable).

4.3.15.3 The alarm system must be connected to an uninterrupted power supply (UPS) including a generator back-up system in the event of a power outage.

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- 4.3.15.4 The system and its associated communications must have a minimum of 48-hour battery power in the event of a power failure/outage and preliminary back-up failure.
- 4.3.15.5 Where no on site security presence exists, the system shall be designed and configured to allow all alarm points specified to be monitored by a remote UL certified Central Station, and the Central Processing unit. The Central Processing Unit shall monitor each individual point status and be capable of individual point programming.
- 4.3.15.6 The Intrusion Detection System shall provide for tampering supervision, of each alarm point, junction box, and associated Cable. This process requirement can be completed via end-of-the-line resistor or other means, if approved by security prior to installation.
- 4.3.15.7 The system shall have the capability of being “activated and/or deactivated” via keypad, or by the use of programmed access cards. Additionally the system shall be designed to allow activation of separate, physical areas or “zones” of the facility. The system shall be configured in such a manner as to allow specified dedicated areas to be controlled on its own dedicated keypad, by authorized personnel only. The other non-specified or “administrative” areas shall be controlled via a separate and dedicated keypad.
- 4.3.15.8 Communications to the remote UL Certified Central station shall have a “supervised” primary communications line and a simultaneous communications back-up. This back up, which must be defined by the Contractor, can be long-range radio, or cellular in design. The system shall have a minimum battery backup of 72 hours.
- 4.3.15.9 The alarm system, at a minimum, should use two dedicated phone lines (POTS) that are routed directly to the system dialer/transmitter. The dialer should provide indication of "trouble" in the event of a system malfunction or phone-line connectivity failure.
- 4.3.15.10 The Contractor will also tender a 1-year monitoring contact for alarm monitoring services at the facility.
- 4.3.16 Magnetic Contacts
 - 4.3.16.1 All magnetic contacts shall be UL® listed, for indoor and outdoor use under Underwriter’s Lab standard 634, and be of

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the “recessed” type whenever possible. In those cases where it is not possible to utilize “recessed”, surface mounted contacts may be substituted, with prior approval of security management. However, should surface mounted contacts be used, all exposed wiring must be in armor covered cable.

4.3.17 Motion Detection

- 4.3.17.1 Motion detectors shall only be dual technology type (PIR and microwave)
- 4.3.17.2 All motion detectors shall be field-adjusted as per manufacturer’s specifications for full coverage pattern of the protected spaces.
- 4.3.17.3 Dual tech360° detectors may be installed where applicable.
- 4.3.17.4 All motion detectors shall have LED’s disabled after initial testing is done.
- 4.3.17.5 Standard of Acceptance: e.g. Optex MX Series, DSC LC-104, Honeywell DT series; 360° Motion Detector: Bosch DS9360

4.3.18 Panic Alarms


- 4.3.18.1 Panic alarm devices can be used as a discreet emergency alarm to provide warning where someone is working (i.e. Reception, Executive Floor) and may need help or when conditions reach an alarming state.
- 4.3.18.2 Standard of acceptance: Make/model of panic device shall be decided in consultation with Corporate Security.

4.3.19 Security Panels


- 4.3.19.1 Security interface panels shall be enclosures with tamper switches to initiate an alarm in the event of an unauthorized opening. All alarm points will be supervised to detect tampering with device wiring.
- 4.3.19.2 Standard of Acceptance: Software House iStar Ultra, Ultra SE; Edge, etc. NO iStar Pro’s.

4.3.20 Intercoms

- 4.3.20.1 All entries to the site shall be configured to have intercoms at the entry and exit side of turnstiles and gates. Intercoms may be wired to a master/exchange either by fiber or network circuit. Intercoms should be IP (network capable) for remote monitoring capability.

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- 4.3.20.2 Intercom systems must be located at every secured entrance provided with card reader to allow communication between access point and the command center. Additional locations may be required via site specific requirements.
- 4.3.20.3 Intercom equipment and devices must be provided at rooms, corridors, offices, laboratories, mechanical areas and process rooms.
- 4.3.20.4 System must provide for 25% spare capacity for future expansion.
- 4.3.20.5 Intercom system must consist of master intercom station, remote stations, power supply and interconnection with telephone system, where applicable.
- 4.3.20.6 Remote stations must allow intercommunication at all of the locations.
- 4.3.20.7 Provisions must be made for the installation of equipment rack (if required), termination block(s) and supports.
- 4.3.20.8 System cables must be terminated in the equipment.
- 4.3.20.9 All cabling must be run in raceway: cable trays or conduit and boxes, as directed. Raceway system must be color marked for identification as per Identification Color Code included in these standards.
- 4.3.20.10 Where new intercom remote stations are required, new conduits (with pull strings) between the station location and the cable tray or security closet must be provided. When cable trays are to be used, the preference is to have the communications cable trays above the ceilings, accessible from corridors.
- 4.3.20.11 When cable trays are provided, all cables must be UL-listed CMP for placement in an air-handling plenum environment.
- 4.3.20.12 All equipment to be installed on classified locations must be labeled and approved for such installation.
- 4.3.20.13 Equipment
 - 4.3.20.13.1 Intercom stations
 - 4.3.20.13.2 Power supply
 - 4.3.20.13.3 Master control station
 - 4.3.20.13.4 Telephone interconnection

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4.3.20.14 Identification Color Code

4.3.20.14.1 Junction and pull boxes must be marked with color codification to facilitate installation, inspection, record and troubleshooting: GREEN.

4.3.20.15 Standard of Acceptance: Zenitel; Stentaphone; Commend

4.3.21 Revolving Doors

4.3.21.1 Revolving doors will be used to maintain access control at building entry points where circumstances dictate the need to maintain the first level of security at the building perimeter.

4.3.21.2 Revolving doors will be configured as follows:

4.3.21.2.1 Door Construction of steel / toughened aluminium / toughened UPVC and toughened glass

4.3.21.2.2 Determine the size of the Active Area.

4.3.21.2.3 Sensor to slow/speed up movement when a person enters and fitted with foot guard safety switch.

4.3.21.2.4 Design to allow for signage to be fitted above the entrance/exit.

4.3.21.2.5 Ceiling construction to be considered.

4.3.21.2.6 Light fittings/lux/light savings.

4.3.21.2.7 Locks – Manual /Magnetic/Electrical/Remote/Alarmed.

4.3.21.2.8 Emergency power release collapse with remote locking capability


4.3.21.2.9 Disabled access capability/ Alternative entry/exit location with Card reader set at a height to facilitate people with a disability

4.3.21.3 Standard of Acceptance: Boon Edam, Horton, Alvarado


4.3.22 Turnstiles

4.3.22.1 Where specified, Personnel with functioning ID Badges for entry to the site or specified area shall be controlled at all locations by electrically actuated turnstiles. All turnstiles shall be full height security turnstiles.

4.3.22.2 Turnstiles shall be configured as follows:


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- 4.3.22.2.1 Fail-safe. Any deviation from this configuration must be approved by the Chief of Public Safety.
- 4.3.22.2.2 Time delay relay to re-lock turnstile in the event a valid read is not accompanied by passage through the turnstile within 30 seconds.
- 4.3.22.2.3 Momentary pulse relays.
- 4.3.22.3 Standards of Acceptance: MSTX series manufactured by Alvarado Manufacturing Company, Boon Edam – SpeedLane, Smartlane 910 – Automatic Systems. ADA Compliant
- 4.3.23 Gates
 - 4.3.23.1 Each site must have the minimum number of vehicle and pedestrian gates required for efficient operation.
 - 4.3.23.2 Gates will be configured as follows:
 - 4.3.23.2.1 Gates must be the same height as the perimeter barrier and consist of chain link or metal gates that slide or swing and are controlled mechanically or manually
 - 4.3.23.2.2 If operated mechanically, closing time must be minimized to reduce the potential for “piggy-backing”
 - 4.3.23.2.3 Gap between gate and gate hinge must not exceed 6”/15CM. A swinging gate must be equipped with a center anchor bolt that extends at least 4” into pavement.
 - 4.3.23.2.4 Gap between the bottom of the fence and the ground must not exceed 6”/15CM.
 - 4.3.23.2.5 If gate is solid metal, guards must have a means to visually assess anyone outside requesting access.
 - 4.3.23.3 Standard of Acceptance: Make/model of gates shall be decided in consultation with Corporate Security.
- 4.3.24 Semaphore Gate Arms:
 - 4.3.24.1 Where practical, Personnel Vehicular and Commercial Vehicle entry to the site shall be controlled at all locations by electrically actuated gate arms. Automobile drive on access control shall use motorized lift gates. Vehicle gate arms shall be

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configured as follows:

- 4.3.24.2 Fail to last position with exit loops in pavement.
- 4.3.24.3 Vehicular entry to the site shall be controlled via HID proximity card access. In addition, two fixed, color; low light video cameras shall be installed. One camera will monitor the vehicle traffic lane; the other will view the occupants of the vehicle from the reader pole. In addition, each reader pole shall be provided with an intercom to communicate with the nearest manned security station as well as the Central Control Station.
- 4.3.24.4 Standard of Acceptance: G90-SE series as manufactured by Federal APD, S8 series as manufactured by Stanley, Magnetic Parking (Pro) From Magnetic Auto controls
- 4.3.25 Emergency Egress Hardware
 - 4.3.25.1 Standard Hardware: In the US, the selected hardware/unit must comply with the NFPA 101® Life Safety Code "the actuating portion of which extends across at least one half of the door leaf". It shall be UL listed for Panic Exit Hardware (UL305) including "the ends of the crossbar or push pad shall curve, guard, or otherwise designed to prevent catching on the clothing of persons during exit" for use on Emergency Exit applications, and tested in accordance to ANSI A156.3 Grade 1 Panic Hardware (250,000 cycles).
 - 4.3.25.2 Audible Alarm equipped – Secondary Exits: The hardware/unit must provide secure, alarmed code-compliant protection for secondary exits. The exit alarm lock should readily identify the door on which it is mounted as an emergency exit and secures the opening against unauthorized use.
 - 4.3.25.3 The hardware/unit shall not allow resetting the alarm after an unauthorized exit, other than by an authorized person with a key. A minimum of 100-decibel audible alarm provides a clear, attention getting warning for an unauthorized exit or attempted exit. The armed indicator light informs the owner that the alarm is armed, and an audible low-battery alert signals the owner to replace the battery when necessary.
 - 4.3.25.4 The selected hardware/unit must comply with the NFPA 101® Life Safety Code "the actuating portion of which extends across at least one half of the door leaf". It shall be UL listed for Panic Exit Hardware (UL305) including "the ends of the crossbar or push pad shall curve, guard, or otherwise designed to prevent

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catching on the clothing of persons during exit" for use on Emergency Exit applications, and tested in accordance to ANSI A156.3 Grade 1 Panic Hardware (250,000 cycles).

4.3.25.5 Standards of Acceptance: Von Duprin Model Number 2670 "Guard-X" Exit Alarm

4.3.25.6 Delayed Egress/Controlled Exit Device is designed to delay egress through an opening using panic or fire exit device for a minimum of 15 seconds. The hardware/unit must meet the exacting requirements of NFPA101, Special Locking Arrangement. The unit shall be designed to be tied into a building's emergency system and will release immediately in an alarm condition.

4.3.25.7 Standards of Acceptance: Von Duprin Model Number CX99 "Chexit" Controlled Exit Device.

4.3.26 Electronic Locks

4.3.26.1 All perimeter doors shall be secured using power mortise locks with crash bar and/or electrified rod type locking hardware. Magnetic locks shall not be used for these applications. All perimeter doors equipped with Card Access Readers shall be configured in a fail-secure fashion, with free egress locking hardware.

4.3.26.2 Interior Doors shall be secured using electrified mortise locks or continuous duty strike locks. All doors shall be designed to be safe for egress at all times. The Manager of Site Security must approve provision of fail-secure doors. Fail secure doors must have UPS/Emergency power with battery/generator capacity for a minimum of 240 minutes for controller and lock power supply.


4.3.26.3 Locker/Cabinet locks – Aperio K100 Cabinet Lock (wired or wireless solution). Make sure wireless locks are supported by panel firmware and current version of CCure9000 software.

4.3.26.4 Standards of Acceptance: Von-Duprin; Locknetics; Assa Abloy; Digilocks

4.3.27 Sound Masking

4.3.27.1 BMS open office configurations require appropriate sound masking systems to increase speech privacy between employees and reduce the distractions in the work place.

4.3.27.2 Sound masking systems will be put in use to protect our

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proprietary information and the Company's competitive advantage.

4.3.27.3 BMS corporate security will be consulted during installation to assist with the design of masking systems.

4.3.27.4 Standards of Acceptance: Soft dB, Atlas 1200 Portable device

4.4 Physical Security System

4.4.1 Locks

4.4.1.1 Heavy duty, commercially rated locksets products are to be utilized for all exterior access/egress points, Interior access/egress points, and rooms containing IT equipment, high-value areas and those areas which may contain confidential and restricted information. The heavy duty keyed lever functions should be used to meet handicap and accessibility codes.

4.4.1.2 Medium duty commercially rated lockset hardware products are to be utilized for all other locations. The keyed lever functions should be used to meet handicap and accessibility codes.

4.4.1.3 All locksets, lock cylinders, rim locks, etc., shall be capable of accepting Best cores or equivalent commercial grade, and capable of accepting changeable cores.


4.4.1.4 The specific determination will be made on what doors are equipped with locksets, passage sets, or other mechanical locking devices. These specifications may vary by project, but must be approved by Security Management. Any and all doors which are supplied with a lockset will be provided with a core keyed to the company key-way, and key-scheme as defined.

4.4.1.5 Standards of Acceptance: Best, Schlage, InstaKey

4.4.2 Key Control Units

4.4.2.1 Key control can be greatly improved by using an electronic enterprise – class key control and tracking software solution. Key Control Units will electronically track key issuance and return with identity management solutions to include preprogrammed pin codes, ID cards or biometric device. Key control solutions should integrate with the Software House access control solution.

4.4.2.2 Standards of Acceptance: Morse Watchmans KeyWatcher, Keyper System, Traka

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4.4.3 Bollards

4.4.3.1

Crash Rating For a perimeter to be considered a hard perimeter, Department of State-rated barriers must be installed around the building to protect against threats from vehicular intrusion. A Department of State-certified barrier receives one of three K-level ratings (K4, K8, or K12) depending on its ability to successfully stop a vehicle with certain associated kinetic energy levels. Kinetic energy levels vary with vehicle weight and speed at impact, assuming the vehicle takes a perpendicular approach, as described in the figure below:

Rating	Speed	Vehicle Weight
K4	30 mph	15,000 lbs
K8	40 mph	15,000 lbs
K12	50 mph	15,000 lbs

- Construction: steel (metal)
- Spacing: no more than 5' 4" (avg car width is 6 feet)
Spacing of bollards in any area where pedestrians might need to traverse needs to be a minimum of three (3) feet to allow for wheelchair ingress and egress. 4' apart is the more common practice
- Diameter: minimum 4" (available in 6" and 8")
- Height: 36 – 40" above ground
- Depth: 12 – 24", usually 18" below grade
- Sleeve: Acceptable over steel (finish, color, style, thickness can be a Facilities decision to match current aesthetics)
- Lighting: yes


4.4.3.2

Standards of Acceptance: Some approved DoD vendors for passive bollards: Nasatka Security (bollards used @ BMS LVL); Secure USA; Barrier 1 Systems and Calpipe Security Bollards.

4.4.4 Fencing

4.4.4.1

Where possible, all production, warehouse and manufacturing facilities will have perimeter fencing to provide the first level of protection at the site and clearly establish the property line. CS will recommend needs based on level of risk.

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4.4.4.2 The fence will be configured as follows:

4.4.4.2.1 Chain link or commercial grade steel.

4.4.4.2.2 Height must be 6 feet / 1.8 meters or higher with an 18" outrigger and three strands of barbed wire or 7' without barbed wire.

4.4.4.2.3 Chain link will have guide wire at bottom and will be reinforced to prevent easy access underneath.

4.4.5 Lighting

4.4.5.1 Lighting at the site must be sufficient to aid guards in detecting intruders and maintaining a safe environment during hours of darkness. The following areas must be lit:

4.4.5.2 Exterior building access points

4.4.5.3 Interior areas close to windows and other access points

4.4.5.4 Parking lots, especially at sites that operate 24/7

4.4.5.5 Lobbies and primary entry ways

4.4.5.6 Perimeter vehicle/pedestrian gates

4.4.5.7 Areas that house processes or facilities designated as critical assets, such as vivaria, product storage areas, laboratories.

4.5 Voice and Data Systems

4.5.1 Data network LAN connection and voice (telephone) communication system must be provided to the new areas. The existing fiber and telephone incoming trunk cables must be used.

4.5.2 Telephone, Data, and Signals services must be extended from the nearest source.

4.5.3 An adequate number of telephone/data communication outlets must be specified in all areas, and as otherwise requested by Owner.


4.5.4 Single and multi-mode fibers must be used for data transmission.

4.5.5 Telephone/data system including communications room and/or remote cabinet(s) must be provided.

4.5.6 System must tie into existing system where applicable.


4.5.7 Telephone/data cabling system must be designed to meet or exceed the site and corporate specifications and technical requirements.

4.5.8 All new cabling, system, faceplates, jacks, patch panels, and associated


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equipment must fall under a manufacturer solution that provides 40 yr Limited Lifetime warranty (example: Berk-Tek's/Leviton Solution or Superior Essex's (nCompass) Solution. New equipment and hardware must match the existing to the extent possible.


- 4.5.9 The cabling systems' contractor must furnish, install, terminate test and provide documented results for the cabling system installation . the cabling system.
- 4.5.10 All cabling must be run in raceway: cable trays or conduit and boxes, as directed. Raceway system must be color marked for identification as per Identification Color Code included in these standards.
- 4.5.11 The distance between any Voice and/or Data outlet to the Communications Center must be kept to 295ft maximum cable length (not to exceed 100 meters end to end).
- 4.5.12 Where new voice / data outlets are required, new conduits (with pull strings) between the outlet location and the cable tray or communications closet must be provided. When cable trays are to be used, the preference is to have the communications cable trays above the ceilings, accessible from corridors.
- 4.5.13 When cable trays are provided, all cables must be UL-listed CMP for placement in an air-handling plenum environment.
- 4.5.14 Data cables must be terminated on rack mounted patch panels. Horizontal and vertical wire managers must be provided to maintain an organized pathway for cross-connect wires.
- 4.5.15 Telephone and data outlets must be provided at those areas where computer terminals and printers are typically used (e.g. offices, laboratories, etc.). Facilities for two (2) telephone connections must be provided per each outlet location.
- 4.5.16 Telephone outlets only must be provided at those areas where computer terminals and printers are not typically used (e.g. hallways, process areas, etc.). Facilities for one (1) telephone connection must be provided per each outlet. Wireless Access Point outlets require facilities for two (2) data connections for each location.
- 4.5.17 Telephones in clean room manufacturing areas shall be hands free and wash down capable.
- 4.5.18 Where required, information outlets must be protected using IP44/NEMA 3R-rated wall plates and device boxes. Multiple outlet location must be provided in common equipment rooms.
- 4.5.19 The active network equipment, such as switches, telephones, PC's and wireless access points must be provided by BMS under a separate contract.

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- 4.5.20 Data network LAN connection and telephone communication systems must be provided to the new areas.
- 4.5.21 All equipment to be installed on electrically classified hazardous locations must be labeled and approved for such installation.
- 4.5.22 Telephone system installed at Security Command Post must be provided with digital recording capability equipment monitoring all incoming telephone calls. System shall provide minimum of continuous 24hrs recording capability. Phone call recording methods to be evaluated base on system design (VOIP versus digital).
- 4.5.23 On designs for laboratory areas, the following apply:
 - 4.5.23.1 Provide dual compartment surface raceway with power and voice/data capability to all benches. In the event that space does not allow for two compartments surface raceway, separate units shall be provided. Data ports shall be of the quadruple port data outlet arrangement, every 36 inches.
 - 4.5.23.2 Provide single port data outlet to all major equipment like fume hoods, laminar flow hoods, etc.; one (1) per equipment.
 - 4.5.23.3 Provide Data outlet for (TRACE) wireless router: one data outlet in corridor per laboratory.
 - 4.5.23.4 When equipment layout is not available:
 - 4.5.23.4.1 Provide one quadruple port data outlet every 36 inches.
 - 4.5.23.4.2 Provide single port data outlet to all available space able to fit major equipment like fume hoods, laminar flow hoods, etc.; one (1) per equipment.
 - 4.5.23.4.3 Provide Data outlet for (TRACE) wireless router: one data outlet in corridor per laboratory.
 - 4.5.23.4.4 Provide dedicated outlet for direct dial (red) phone in laboratory, one per laboratory.
- 4.5.24 Equipment
 - 4.5.24.1 System racks
 - 4.5.24.2 Telephone and data switches
 - 4.5.24.3 Patch panels
 - 4.5.24.4 Fiber optic cable(s)

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- 4.5.24.5 Fiber to copper converters
- 4.5.24.6 Wireless access points
 - 4.5.24.6.1 Wireless access points are defined by BT our Global supplier.
 - 4.5.24.6.2 For wireless In hazardous areas devices to be located in explosion proof boxes.
 - 4.5.24.6.3 Approved vendor and model
 - 4.5.24.6.4 Enclosure: Analynk AP300
 - 4.5.24.6.5 Coupler: Soldo Wireless AX type coupler
 - 4.5.24.6.6 Antennas: Passive type
- 4.5.24.7 Telephones
 - 4.5.24.7.1 General Purpose (Non-Classified) Indoor Areas
 - 4.5.24.7.2 Specified by BT
 - 4.5.24.7.3 General Purpose (Non-Classified) Outdoor Areas
 - 4.5.24.7.4 Specified by BT
 - 4.5.24.7.5 Classified Areas
 - 4.5.24.7.6 Intrinsically safe (for use in class I div. I, class II div. I)
 - 4.5.24.7.7 Make: Gai-Tronics Model 262-001 for indoor locations and model 271.00 for outdoor locations.
 - 4.5.24.7.8 Isolation Barrier: Gai-Tronics model 263.00. Located in electrically unclassified general purpose areas.
 - 4.5.24.7.9 Hazardous area Phones (for use in class 1 div. II and class II div. II areas)
 - 4.5.24.7.10 Make: Gai-Tronics model 351.001
 - 4.5.24.7.11 Clean Rooms
 - 4.5.24.7.12 These should be of type
 - 4.5.24.7.13 Mounting: flush recessed in back box (12"x12"x2"D).
 - 4.5.24.7.14 Front: Completely smooth panel, sealed.
 - 4.5.24.7.15 Buttons: Oversized.

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- 4.5.24.7.16 Automatic Dial: Two numbers for quick communications.
 - 4.5.24.7.17 Speaker Output: 85 dBA at 1 meter.
 - 4.5.24.7.18 Make: Gal-Tronics Model 295 with power supply.
 - 4.5.24.8 Wall Outlets
 - 4.5.24.8.1 Wall outlets shall have a four inch by four inch by two inch (4"x4"x2") box with single gang device ring of depth required.
 - 4.5.24.8.2 Wall plates shall have finish to match switch plates.
 - 4.5.24.9 Floor Outlets
 - 4.5.24.9.1 Floor boxes shall be galvanized steel with concrete tight openings; five eighths inch (5/8") vertical adjustment and has the ability to tilt ten inches (10") after concrete pour; brushed bronze face plate; Make: T & B 1754, or approved equal.
 - 4.5.24.9.2 Device enclosure shall be cast aluminum with brushed finish and captive locking screw or other positive means to prevent turning, one inch (1.5") bushed opening, T & B 1855 or approved equal.
- 4.5.25 Identification Color Code
 - 4.5.25.1 Junction and pull boxes must be marked with color codification to facilitate installation, inspection, record and troubleshooting: ORANGE.
- 4.5.26 Reference
 - 4.5.26.1 Refer to DS-SKE5 Voice and Data Systems
- 4.6 Emergency Communication Systems
 - 4.6.1 Call Boxes (Wired or Wireless):
 - 4.6.1.1 Provide a callbox containing a special-purpose direct communication to facilitate contacting from a remote location to a central dispatch office and/or the central Security Office.
 - 4.6.1.2 The call boxes shall be located at regular intervals within a parking lot and similar areas as approved by Corporate Security and EHS.

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- 4.6.1.3 The call boxes shall be marked by a blue strobe light. They should be provided with solar cells for electrical power. Provisions for hearing impaired users shall be included.
- 4.6.1.4 If the required distance is greater than the range of the wireless call box, an external antenna to extend the range shall be provided.since no power lines need be run to it.
- 4.6.1.5 Equipment
 - 4.6.1.5.1 Emergency call box
 - 4.6.1.5.2 Solar power system (including batteries, charger, etc.)
 - 4.6.1.5.3 Mounting pole
 - 4.6.1.5.4 Strobe light on top
 - 4.6.1.5.5 Controller
 - 4.6.1.5.6 Repeater
 - 4.6.1.5.7 Interface to communicate with existing central communication facility
 - 4.6.1.5.8 Automatic call alert system
 - 4.6.1.5.9 Automatic verbal user instructions
- 4.6.2 Emergency Phones
 - 4.6.2.1 Where circumstances dictate due to elevated risks, emergency phones will be installed and integrated into the access control and video management system. Consideration should be given to using open architecture that will leverage emergency phones with mass notification system tied into the security control center.
 - 4.6.2.2 Standard of Acceptance: Call Box 24, Commend emergency call box
- 4.6.3 Red Phone Systems:
 - 4.6.3.1 The intention of the “red phone system” is to provide direct access to the command center.
 - 4.6.3.2 Provide dedicated outlet for direct dial red phones in a spacing no less 50 feet and/or as approved/required by EHS based on hazard assessment. Typically located in the hall way outside the Laboratory ringdown type to security with no dial pad.

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- 4.6.4 Blue Light Systems:
 - 4.6.4.1 The BAS shall provide signals to the Fire Alarm system for activation of the blue strobes associated with laboratory exhaust system failures.
 - 4.6.4.1.1 Strobe locations to include corridors, lobbies, rest rooms, conference and meeting rooms, copy rooms, open office areas, laboratory areas,
 - 4.6.4.1.2 Areas where multiple strobes are in view will utilize synchronization protocol required by NFPA 72.
- 4.7 Paging/Public Address System
 - 4.7.1 Paging/Public Address system must be provided for non-emergency use (Fire Alarm System will provide voice activated notification for emergency use).
 - 4.7.2 Paging/Public Address equipment and devices must be provided at corridors, offices, laboratories, mechanical areas and process rooms.
 - 4.7.3 Paging/Public Address system must consist of speakers, loudspeakers, voice amplifier, interconnection with telephone system, where applicable. Voice amplifier must be provided with master volume control for the entire system. Speakers must allow paging to be heard at all of the locations.
 - 4.7.4 Where required, speaker placement must allow paging to be heard at all of the locations within the building.
 - 4.7.5 Outdoor speaker placement could allow paging to be heard at selected locations out of the building,
 - 4.7.6 All speakers must be suitable for the area in which must be located.
 - 4.7.7 System must provide for 25% space capacity for future expansion.
 - 4.7.8 Closed areas must be provided with local volume control for the associated speakers.
 - 4.7.9 Provisions must be made for the installation of equipment rack (if required), termination block(s) and supports.
 - 4.7.10 System cables must be terminated in the equipment.
 - 4.7.11 All cabling must be run in raceway: cable trays or conduit and boxes, as directed. Raceway system must be color marked for identification as per Identification Color Code included in these standards.
 - 4.7.12 Where new Paging/Public Address system and/or outlets are required, new conduits (with pull strings) between the outlet location and the cable tray or communications closet must be provided.

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- 4.7.13 When cable trays are to be used, the preference is to have the communications cable trays above the ceilings, accessible from corridors.
- 4.7.14 When cable trays are provided, all cables must be UL-listed CMP for placement in an air-handling plenum environment.
- 4.7.15 All equipment to be installed on electrically classified hazardous locations must be labeled and approved for such installation.
- 4.7.16 Equipment
 - 4.7.16.1 Speakers
 - 4.7.16.2 Loudspeakers
 - 4.7.16.3 Power supply
 - 4.7.16.4 Voice amplifier
 - 4.7.16.5 Local / remote volume control
 - 4.7.16.6 Telephone interconnection.
- 4.7.17 Identification Color Code
 - 4.7.17.1 Junction and pull boxes must be marked with color codification to facilitate installation, inspection, record and troubleshooting: GREEN.
- 4.8 Audiovisual System
 - 4.8.1 Audiovisual system must be provided in conference rooms.
 - 4.8.2 Audiovisual system must consist of master control, wired microphone(s), wireless microphone(s), speakers, voice amplifier, VGA-XGA-SXGA video projector (ceiling mounted preferable), ceiling mount structure and false ceiling plate (where indicated), manual (or motorized, as directed) 100" diag screen, VGA BNC-5 interconnection cable(s), SY / VGA adapters, VGA interconnection cables, data interface (where required) and interconnection with telephone system, where applicable.
 - 4.8.3 Provisions must be made for the installation of equipment rack (if required), termination block(s) and supports.
 - 4.8.4 All cabling must be run in raceway: cable trays or conduit and boxes, as directed. Raceway system must be color marked for identification as per Identification Color Code included in these standards.
 - 4.8.5 Where new system outlets are required, new conduits (with pull strings) between the outlet location and the central system must be provided.
 - 4.8.6 All equipment to be installed on classified locations must be labeled and approved for such installation.


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- 4.8.7 Input/output switch to reduce cabling system must be provided.
- 4.8.8 Equipment
 - 4.8.8.1 Master control
 - 4.8.8.2 Wired and/or wireless microphone(s)
 - 4.8.8.3 Speakers
 - 4.8.8.4 Voice amplifier
 - 4.8.8.5 VGA-XGA-SXGA video projector (ceiling mounted preferable)
 - 4.8.8.6 Ceiling mount structure and false ceiling plate (where indicated)
 - 4.8.8.7 Manual (or motorized, as directed) 100" diagonal screen
 - 4.8.8.8 VGA BNC-5 interconnection cable(s)
 - 4.8.8.9 SY / VGA adapters
 - 4.8.8.10 VGA interconnection cables
 - 4.8.8.11 Data interface (where required)
 - 4.8.8.12 Interconnection with telephone system, where applicable.
- 4.8.9 Identification Color Code
 - 4.8.9.1 Junction and pull boxes must be marked with color codification to facilitate installation, inspection, record and troubleshooting: White.
- 4.9 Non-Secured Door Interlocks
 - 4.9.1 Where required, door interlock system to prevent area cross contamination must be provided. Non-secured door interlock system must include, but not limited to: magnetic locks, electric strikes, electric lock set, door contacts, FA release, interlock disable, motion sensor, infra-red sensor, safety interlock, etc. All door interlocks shall be fail open (release) in the event of a FA system activation. Where maglocks are used, they must be installed to meet applicable safety rules and regulations of Life Safety codes, Refer to BMS-OCD-3kS4 Occupational Health and Safety Standards Manual Life Safety Chapter.
 - 4.9.2 Interlocked doors must be wired to stand alone interlock controller(s). The system must be designed to prevent the simultaneous opening of multiple doors in the airlock. Active airlock systems must be equipped with both local emergency release override stations (one at each interlocked door) and an interface to the building fire alarm system for automatic release upon the activation of an alarm condition.
 - 4.9.3 All equipment to be installed on electrically classified hazardous locations

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must be labeled and approved for such installation.

- 4.9.4 Door interlock system must be configured on a fail safe basis: locks to be kept de-energized until lock capability is required.
- 4.9.5 All cabling must be run in raceway: cable trays or conduit and boxes, as directed. Raceway system must be color marked for identification as per Identification Color Code included in these standards.
- 4.9.6 Equipment
 - 4.9.6.1 Doors Interlock Controllers
 - 4.9.6.2 Magnetic Personnel Door Switches
 - 4.9.6.3 Request to Exit Motion Sensors
 - 4.9.6.4 Electric Lock
 - 4.9.6.5 Magnetic Locks
 - 4.9.6.6 Electric Strike
- 4.9.7 Identification Color Code
 - 4.9.7.1 Junction and pull boxes must be marked with color codification to facilitate installation, inspection, record and troubleshooting: BLUE.
- 4.9.8 Reference
 - 4.9.8.1 Refer to Sketch DG-E7 Non-Secured Door Interlocks
- 4.10 Alarms
 - 4.10.1 All wiring for alarms systems shall be installed in raceway system. Refer to BMS-ENG-DS-2015: Design Standard for Building Power Distribution for details.
 - 4.10.2 All utility equipment shall be wired to the Building Automation System (BAS). Refer to BMS-ENG-DS-2045: Design Standard for Automation Systems.
 - 4.10.3 All process equipment shall be wired to the applicable process control system. Refer to BMS-ENG-DS-2045: Design Standard for Automation Systems.
 - 4.10.4 All Life Safety alarms shall include provisions to report at the Main Security System.
 - 4.10.5 Other critical alarms (miscellaneous) that may require reporting to the main Security System including:
 - 4.10.5.1 Emergency shutdown system activation
 - 4.10.5.2 Life safety alarms (oxygen asphyxiation monitors, eye wash/safety shower operation, call boxes)

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4.10.5.3 Critical temperature alarms on coolers, freezers, or storage areas

4.10.5.4 Failed utility alarms (power supplies, boilers, compressors, etc.)

4.11 Data Centers/Server Rooms


4.11.1 Installation Categorization / Terms

4.11.1.1 Electronic equipment areas should be categorized based on their criticality and the required reliability as follows:

4.11.1.1.1 Essential ("A" Installation): "A" installations are considered essential to the business. Loss of these facilities would have wide ranging negative effects to production, manufacturing or economic issues to the corporation. They are designed to be operated and maintained with essential services uninterrupted to the end use systems. Generally all systems are redundant to "N plus one" standards. Outages of any kind are unacceptable to designated equipment. System failures of major components are transparent to the end users and back up systems are fully automated.

4.11.1.1.2 Vital but not Essential ("B" Installation): "B" installations are considered vital but not essential to the business. Loss of these facilities would have a local/regional negative effect to production, manufacturing or economic impact. They are designed to be operated and maintained with minimal impact to essential services. Scheduled downtime is acceptable. System failures may need human intervention.

4.11.1.1.3 Baseline / Local Effects ("C" Installation): "C" installations are the minimal accepted standard or baseline for company data centers / electronic equipment rooms. The losses of these facilities have significantly smaller impact to the BMS population / business needs. Their loss would represent an inconvenience. LAN closets are defined within this criteria when they are a subset of a much larger installation.

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4.11.2 Fire Protection

4.11.2.1 For data center fire protection methods refer to BMS-ENG-DS-2030: Design Standard for Fire Protection.

4.11.3 Electrical Power

4.11.3.1 Electrical Power and building distribution design methods will be covered in BMS-ENG-DS-2015: Design Standard for Power

4.11.4 Location And Construction Criteria

4.11.4.1 All electronic equipment areas shall incorporate the following location and construction details.

4.11.5 Site Selection Criteria

4.11.5.1 Electronic equipment should be installed in areas where danger from fire, smoke and explosion is minimal.


4.11.5.2 A factor to be consider is structural design to resist the effects of hurricanes, earthquakes, tornadoes, high winds, etc. A thorough survey should be conducted prior to installation location to identify potential threats to the equipment.

4.11.6 Housing Structure

4.11.6.1 Existing structures used to house electronic equipment shall be either fire-resistive or of noncombustible construction. New structures built to house electronic equipment shall be fire-resistive or noncombustible construction. All structural members including walls columns, piers, beams, girders, trusses, floors and roofs shall be of materials which are noncombustible or possess limited combustibility as opposed to materials which are inherently combustible but have been treated to give them fire-retardant qualities.

4.11.6.2 Materials used for interior finishes, insulation, vapor barriers, shielding or acoustical treatments shall have a surface flame spread rating of 25 or less (applicable safety rules and regulations) and shall possess a "smoke developed" or specific optical density of 50 or less (flaming) (applicable safety rules and regulations). To the extent feasible, FM approved materials shall be selected for construction.

4.11.6.3 In multi-story structures, the equipment may be located on any floor including the mezzanine or penthouse. Basements should not be considered for locating electronic equipment due to water damage from flooding, backed-up sewer lines, broken

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water lines, hurricanes, fire-fighting operations or from liquid processes located above.

4.11.6.4 If the use of a basement is unavoidable, the following should be provided:

4.11.6.4.1 Provide floor drainage equipped with backflow preventer.

4.11.6.4.2 In unattended electronic equipment rooms, provide liquid detection devices, located near floor drain(s) and wired to annunciate to an attended location.

4.11.6.4.3 Ensure that surface water drainage is away from the building and that any ground level openings are made water tight this includes sealing basement floors to prevent ground water entry.


4.11.6.4.4 Where it is felt that an above average probability exists of water entering the below grade building level, a sump pump and sand bags should be available in the installation to help evacuate water and to prevent ingress of water into the electronic equipment room from any openings between the electronic equipment room and adjacent areas.

4.11.6.5 When the equipment is located against an exterior building wall provide a three-hour rated masonry or concrete wall.

4.11.6.6 When electronic equipment is to be housed in structures containing other occupancies, the following factors shall be considered to assure that the electronic equipment is not susceptible to danger as a result of fires in other occupancies:

4.11.6.6.1 Equipment areas shall be separated from other occupancies by two-hour fire rated floors and partitions, minimum. The structural framing system shall be designed so that a fire external to the electronic equipment area cannot cause a structural failure that will cause damage within the electronic equipment area.

4.11.6.6.2 The floor above electronic equipment shall be adequately waterproofed to prevent passage of accidental spillage, wash water or leakage.

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4.11.6.6.3 Where any serious potential of water spillage exists on the floor within the electronic equipment area, the necessary curbs, sills and floor drains should be provided.

4.11.6.7 Roofing – Roofing for “purpose built” facilities shall be a 60 mil EPDM membrane per BMS specification #07535.00.

4.11.6.8 Perimeter Separation Criteria – The following requirements are designed to provide fire-resistive separation between the electronic equipment area and adjoining areas.

- 4.11.6.8.1 Openings in fire-resistive separations shall be protected by fire doors, fire windows, fire dampers or glass block subject to the following:
- Fire windows or fire resistant glass block meeting the requirements detailed below for viewing windows may only be used for openings which are subject to light fire exposure and which are protected by automatic sprinklers.
 - Because of the potential of smoke and fire damage, all openings in the separation, except ducts, should be protected with normally closed doors, fixed fire windows or glass block.
 - Fire dampers having a fire-resistive rating of at least 1-1/2 hours shall be used in ducts at the point(s) where the duct penetrates the perimeter wall(s).

- 4.11.6.8.2 Viewing windows and special architectural treatments for entrance doors may be provided in the separation provided they do not violate the fire integrity of the separation. Some methods of accomplishing this are:
- The use of double sets of doors, one set of normally closed architecturally desirable doors of any construction and a second set of fire doors held in the open position and released by the automatic fire protection system. The fire doors may, if desired, be concealed. In such installation, the swing of

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the architectural doors shall not interfere with the operation of the fire doors.


- When the fire exposure in the adjacent portions of the building is light and the area is protected with automatic sprinklers, a fire window assembly may be used for a viewing window.
- When extending the electronic equipment area to include a low fire hazard corridor, conference rooms or similar area, the requirements for the fire-resistive cutoffs and fire doors or other protected fire openings will apply to the entire area included in the electronic equipment area.

4.11.6.8.3 The total area of all openings in a fire-resistive separation shall be as small as practicable.

4.11.6.8.4 Adequate fire stopping shall be provided to sufficiently seal all penetrations of fire walls, fire partitions and floor slabs above and below the electronic equipment or record storage area. Openings made for ducts, conduit, cables, pipe or other utilities shall be sealed with material adequate to resist passage of heat, flame and smoke for a period of time equal to the fire resistive rating of the building element penetrated. Room sealing must also support a pressure test that will ensure effective application of gas agent fire systems where supplied.


4.11.7 Interior Construction Criteria

- 4.11.7.1 All interior wall and ceiling finishes in the electronic equipment area shall have a Class A rating.
- 4.11.7.2 Interior floor finishes used in electronic equipment areas shall be Class I.
- 4.11.7.3 Exposed cellular plastics shall not be used in electronic equipment area construction.
- 4.11.7.4 When areas in an existing structure are to be converted for use as electronic equipment areas, all nonstructural combustible


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materials within the equipment areas shall be removed except as permitted below:

- 4.11.7.4.1 Minimum amounts of exposed combustible moldings and trim are permitted.
- 4.11.7.4.2 When a raised floor system is installed in an area having combustible flooring or floor covering, a noncombustible material shall be installed over the flooring or floor covering.
- 4.11.7.5 Raised floor systems in electronic equipment areas shall be of noncombustible materials, except minimum amounts of vinyl or rubber materials are permitted for leveling, sealing, etc., or to prevent horizontal shifting of floor panels or decking.
 - 4.11.7.5.1 The structural supporting members for raised floors shall be of noncombustible or Class I materials.
 - 4.11.7.5.2 Flooring, decking, fascias, closure panels, edging, handrails and ramps shall be of noncombustible or Class I materials.
 - 4.11.7.5.3 Commonly used floor covering materials such as low static generating resilient floor tiles and high-pressure laminates may be used on the raised floor deck. Carpeting is not permitted in new installations. In existing installations, carpeting over a raised floor may be considered a tolerable situation if it meets the requirement of 0.45 watts / cm² as per applicable safety rules and regulations, does not restrict the lifting of floor panels, and is an area protected by automatic sprinklers or a total flooding gaseous extinguishing system.
 - 4.11.7.5.4 Breakers and switches are not permitted under raised floors.
 - 4.11.7.5.5 Power supply conductors under raised floors shall be metal conduit or jacket in accordance with applicable safety rules and regulations. Recommend overload signaling device. Cabling shall be of low flame spread rating.
 - 4.11.7.5.6 No storage permitted in raised floor area.

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- 4.11.7.6 Non Raised Floor/ Slab is also an acceptable and preferred for new Data/Server Rooms but should be discussed and approved by Hosting Operations.
- When the concealed space formed by a ceiling or floor assembly is used as a supply or return air plenum, installation shall conform with the appropriate provisions of applicable safety rules and regulations.
- 4.11.7.7 Ceilings should be provided with access doors, panels, hatches or other means of ready access to all portions of the concealed space above.
- 4.11.7.8 Hot/Cold Aisle Containment systems should be considered for all new Data Center/Server room installations.
- 4.11.7.8.1 Preferred installation would contain the hot aisle with ducted hot air return back to the CRAC units. Vented downward cold air supply to the Cold aisle.
- 4.11.7.8.2 Cold aisle containment is also a suitable installation
- 4.11.7.8.3 Both the Hot/Cold Aisle solutions should be reviewed and approved in conjunction with Hosting Operations
- 4.11.7.9 Ceilings should be provided with access doors, panels, hatches or other means of ready access to all portions of the concealed space above.
- 4.11.7.9.1 Fire-resistive separations between separate electronic systems shall extend from deck to deck and be of noncombustible or limited combustibile material having a fire-resistive classification greater than the maximum fire potential of either electronic system. In no case shall the fire resistive be less than 1 hour.
- 4.11.7.10 A separate room for a Record Library shall be provided for functions requiring the use, manipulations and storage of significant quantities of record materials. The perimeter construction of the electronic equipment area and the record library may include a common separation. That portion of the separation which is common shall have a minimum 2-hour rating and all other separations shall meet the requirements

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above.

4.11.7.11 Vital or important records regularly kept in the electronic equipment room that have not been duplicated and stored elsewhere should be stored in Class 150, 1-hour rated protection equipment. All other records should be stored in normally closed metal cabinets.

4.11.7.12 Generator houses or other facilities using flammable / combustible liquids shall be located a sufficient distance from electronic equipment so as not to present a fire exposure to electronic equipment. The separation shall be at least 50 feet unless the natural terrain or other noncombustible barricades provide a fire barrier between the fuel and electronic equipment.

4.11.8 Separation Criteria

4.11.8.1 The following types of equipment and operations should be located in separate cut-off rooms due to their different fire frequencies and / or severity's, so as to not create unnecessary inter-exposures:

4.11.8.1.1 Electronic system central processing units.


4.11.8.1.2 Electronic system peripheral equipment that involves the use of ordinary combustibles in the immediate area (e.g., printer, disk / tape drives). Location of disk/tape drives in the room housing the CPUs is tolerable if there is not accompanying media storage within the same room.

4.11.8.1.3 I/O communications equipment.

4.11.8.1.4 Tape and/or cassette storage.

4.11.8.1.5 Self-contained, automated mass storage units should preferably be in separate room but location in the general tape and/or cassette storage room is tolerable. Location in the room containing CPUs is tolerable if the interior of the unit enclosure is protected by an automatic gaseous extinguishing system or if the unit is small enough not to warrant any automatic protection.

4.11.8.1.6 Power / frequency regulating devices (not


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including UPS systems and emergency power supplies; see below) should preferably be in a separate room, but location in a room with CPUs or electronic system peripheral equipment is tolerable if the equipment is an integral part of the electronic system.

- 4.11.8.1.7 Permanently connected uninterruptible power supplies (UPS) and emergency power supply systems. There should be no door(s) leading directly into the room(s) containing electronic equipment or record storage. For temporary system installations that must be located in the electronic room, a minimum separation of 10 feet should be provided to all nearby combustibles.
- 4.11.8.1.8 Other occupancies related to the electronic operation but not involving electronic equipment (e.g., offices for supervisors, programmers or security, maintenance and / or repair shops, paper records storage).
- 4.11.8.1.9 Fire Supression Systems

4.11.9 Considerations: Recommended separation of values

- 4.11.9.1 For very large or high value electronic equipment installations, consideration should be given to providing as many smoke-tight subdivisions as is practical, in order to limit the extent of thermal and non-thermal damage due to a single incident. Suggested guidelines include limiting continuous areas to 5,000 sq.ft. if practical, or 10,000 sq.ft. at most. For operations involving more than one electronic equipment system, locate critical components of each system in a separate cut-off area if practical.
- 4.11.9.2 For existing installations where the loss expectancy due to a single incident is unacceptably high, smoke-tight subdivisions may be installed to reduce design loads where gaseous extinguishing system are provided to reduce the loss expectancy to acceptable levels.
- 4.11.9.3 Cutoff walls should preferably have a 1-hour rating, but may be of any noncombustible material that can provide a smoke-tight barrier if the occupancy on each side of the wall is protected

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with automatic sprinklers.

4.11.9.4 The walls should span from slab to slab. Ordinary glass should not be used in the cutoff wall if the occupancy on either side involves a combustible loading any higher than that of electronic equipment alone.

4.11.9.5 Preferably, an electronic equipment should not be directly connected to any supporting areas (e.g., tape, cassette, or disk storage, I / O rooms, UPS equipment, etc.). Where storage rooms or UPS equipment rooms open into the electronic equipment room, a second entrance should be available to each of the support rooms so the electronic equipment room need not be exposed to heat, smoke, and / or fumes during fire fighting operations in one of these support areas.

4.11.10 Security Considerations

4.11.10.1 Adequate security should be one of the considerations to be weighed, whenever plans are being made to establish and electronic equipment installation. A security representative should be involved in early planning of the installation to insure that the site selection, layout, and building design will effectively incorporate security requirements. The basic objective of integrating security into the site layout is to achieve the most effective utilization of protection for the installation.

4.11.10.2 In developing security measures for the installation, certain attributes need to be considered, such as; location of the site, number of entrances, who will have access, types of security equipment, installation categorization, etc.

4.11.10.3 Location


4.11.10.4 Computer installations should be located in an area in the center of the facility, which will diminish the capabilities of unauthorized entry.

4.11.10.5 Number of Entrances and Exits

4.11.10.5.1 The number of doors leading into the installation should be minimal, thus being able to control entry.

4.11.10.6 Access

4.11.10.6.1 The responsible person for the installations should control access. Access should be granted to only those who have an absolute need to

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enter the installation. Individuals who service the installation should be made to sign in and be accompanied by a Bristol-Myers Squibb employee where required.

4.11.10.7 Security Equipment

4.11.10.7.1 All doors leading into the installations should be equipped with card readers. The card readers should be controlled and monitored by the security console and any violations observed should be responded to immediately. Card readers allow for time and attendance and can be set up to accommodate work schedules. Only essential personnel should be granted 24-hour access. CCTV cameras should be installed and each camera should have the capabilities of recording the activity in the site. Storage areas such as tape rooms and supply closets should be alarmed so that entry can be accounted for. Depending on the category of the installation, Security personnel may be required to insure that the installation is protected adequately.


4.11.10.8 Installation Categorization

4.11.10.9 It is important to establish the criticality of the installations when establishing security requirements.

4.11.10.9.1 If the installation is categorized as an essential operation center, then the specifications as described above should prevail.

4.11.10.9.2 As the installations diminish in criticality the security requirements will also decrease. Installations that do not meet the essential category should be reviewed and proper security precautions should be established.

4.11.10.9.3 The design for those installations that are categorized as "B" should include card readers and CCTV capabilities. The need for security personnel to protect the installation is not necessary. It is, however, important that security management remain part of the development of the installation. Security involvement will insure


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the proper protection for the facility.

- 4.11.10.9.4 Those installations designated as “C” should include card readers and CCTV capabilities. The need for security personnel to protect the installation is not necessary. It is, however, important that security management remain part of the development of the installation. Security involvement will insure the proper protection for the facility.


4.12 Voice/Data Cabling

- 4.12.1 This document is prepared as an additional design standard to supplement Data Centers. It should be utilized as appropriate, based upon the delivery for two primary audiences, Where conflicts occur within document, the most restrictive provisions shall prevail.
- 4.12.1.1 The first audience is for facilities engineers who are involved with building construction, or existing space renovation. In most of these conditions, there will be requirements to install new voice/data cabling facilities. This document is to be used as a design standard to create the spaces required to support these requirements, as well as provide familiarization as to the technical standards required for cable installation.
- 4.12.1.2 The second audience is for those (whether in facilities or IT organization) that have responsibilities for designing, contracting and/or installing voice/data cabling within Bristol-Myers Squibb. This document sets forth the detailed design standards for installing new cabling, both in new facilities/spaces, as well as in existing locations.
- 4.12.2 This document sets the standards for how the majority of BMS facilities should be cabled. However, it is recognized that business requirements may dictate that limited alternatives to these design guidelines be pursued and implemented. It is strongly recommended that design alternatives to the standards be discussed and approved prior to committing to their implementation. All discussion to involve BMS Hosting and Network Operations, BMS Service providers BT, HP etc.
- 4.12.3 The products specified within shall be considered standardized US material and shall be used in all installations, unless otherwise permitted. The use of other material other than those in which have been specified will only be accepted in markets outside North America, in cases where they are out readily available. Any substituted material (outside North America) shall

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comply with the following requirements:

- 4.12.3.1 Meet or exceed all performance requirements.
- 4.12.3.2 Provide equal to or greater warranty coverage (length of time, performance guaranties, application ensures).
- 4.12.4 Data Center/Server Room/Main Distribution Frame (MDF)
 - 4.12.4.1 The Data Center/Server Rom/MDF is a facility that is used as a building's central distribution point (Building Distributor - DP). It is used to distribute any or all communications services (voice or data) throughout a single-level or multi-level building. This facility may act as a Telecommunications Room or distribute services to other Telecommunications Rooms within the same facility. The MDF may also contain a building's demarcation point or Point of Presence (POP).
 - 4.12.4.2 Facility Standards - Intent of Data Center/Server Room/MDF's
 - 4.12.4.2.1 Central Distribution Point for Core Data and/or Voice equipment.
 - 4.12.4.2.2 May contain the Point of Presence (POP) – Point in which inter-building cabling (OSP cabling) enters a building.
 - 4.12.4.2.3 Maybe used as a Demarcation Point – a location where inter-building cabling and/or an access provider's cabling terminates within a facility.
 - 4.12.4.2.4 The Data Center/Server Room/MDF can support Data and Voice communications equipment (Servers, IT, equipment, storage, network, voice, appliances, circuits, etc.)
 - 4.12.4.3 Room Construction
 - 4.12.4.3.1 Size – The size of the Data Center/Server Room/MDF should be based on the types of services and equipment that will be contained within this space (allowing for proper clearances).
 - The final size should be based on equipment, working clearances, and/or access or service provider space requirements (as needed).
 - 4.12.4.3.2 Location – Since the Data Center/Server Room/MDF can have a significant impact on


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other related facilities and services, its ultimate location must be considered carefully. Survey the areas adjacent to as well as above and below to ensure that there is no potential service disrupters (e.g. water or EMI sources). Other factors that may be considered in determining final location are:

- Determining growth potential and providing for future expansion;
- Access for equipment (delivery);
- Access or proximity to backbone cabling pathways (ideal if vertically aligned with Telecommunications Rooms (TR)).

4.12.4.3.3 General Room Construction Elements

- Room must be painted in a light color to enhance lighting conditions.
- Ceiling height must be a minimum of 10ft. (12 ft. preferred). Drop ceiling is recommended but not required.
- Data Center/Server Room/MDF may be equipped with two walls covered with a 3/4" AC Grade (fire rated seal must be visible) plywood or appropriately rated or painted backboard of at least 8' x 8' section – (black in color). Exposed side will be smooth. If reusing an existing backboard, contractor will remediate holes left from the removal of equipment to achieve the "smooth surface" requirement prior to repainting. A final review must be performed before final size and location are chosen.
- Data Center/Server Room/MDFs containing a facilities POP or demarc point maybe required to have some or all of the following to ensure that the installation complies with all local/national codes and/or regulations: (a) Appropriate surge protection; (b) Appropriate grounding and bonding (earthing); (c) Appropriately rated hardware


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and cabling; (d) Appropriately seal conduit entrances.

4.12.4.3.4 Electrical Requirements – Due to the sensitive nature of this facility and the equipment installed within, the electrical circuits must be dedicated to the service of this facility only.

- Lighting and other equipment located within the room (e.g., HVAC) must be supplied by a separate feeder.
- A minimum of Six (6) dedicated 208V/30A circuits shall be mounted in a duplex receptacle located on the back side of each relay rack(s), 18" AFF. In some cases we may need Six (6) or more depending on equipment requirements. This should be reviewed with Hostring and Network Operations during the BOD.
- Use of NEMA receptacles unless otherwise directed. Please note that the circuit sizes indicated are intended for bidding purposes only.
- When one (1) UPS is in use, the above circuits must be installed so that ½ the circuits are from UPS and 1/2 off house power.
- When there are multiple UPS in use each circuit should be installed so that ½ the power supplies are from one (1) UPS and the other ½ are from the 2nd UPS.
- At Least one (1) 120 V convenience outlet must be located on each surrounding wall for tools and testing unless otherwise specified.

4.12.4.3.5 UPS / Generator Support – The following are initial requirements based on generic specifications. Actual load requirements must be determined based on the equipment loads for the intended for room. All equipment details shall be coordinated with the appropriate IT staff.

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- Where centralized UPS supports services in the building, the Data Center/Server Room/MDF should be connected to the generator to support circuits installed.
- Where centralized UPS does not exist as defined above, switch/room UPS equipment will need to be acquired. Design objectives for room/switch UPS are as follows: (a) 30 min run time, (b) 60 min run time, if VoIP applications exist.
- Where backup generator(s) exists and provides service beyond essential life safety support, the Data Center/Server Room/MDF in the building should be connected to the generator to support the circuits in 2.d from above, along with room lighting and air conditioning supporting the Data Center/Server Room/MDF as defined below.

4.12.4.3.6 Lighting Requirements

- Minimum lighting requirements: 50 foot-candles (500lux) measure 3ft AFF.
- Lights should be positioned in front and in back of relay racks/cabinets.
- A minimum of one (1) light in the Data Center/Server Room/MDF should be configured with battery ballast for Emergency lighting. More may be required depending on the overall size of the approved space.
- If installed lighting is not indirect, then tube guards shall be installed to ensure glass fragments are kept away from equipment in case of breakage.

4.12.4.3.7 HVAC Requirements

- Provide HVAC that will maintain continuous and dedicated environmental control (24 hours per day, 365 days per year). Maintain positive pressure with a minimum of one air

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change per hour in the Data Center/Server Room/MDF.


- Dissipate the heat generated by active devices. HVAC capacity for the Data Center/Server Room/MDF should be based on the actual electrical loads of this room. Minimal A/C capacity shall permit 1 ton of A/C per 12kBTUs.
- Provided HVAC should maintain a temperature range specified in ASHRAE Technical Committee 9.9, recommended **64.4°F to 80.6°F**. The humidity range should be 45% to 55% relative humidity.
- Filtration specifications should meet those referenced in BMS-ENG-DS-4301: Design Standard for HVAC, and reference ISO Standard Series 14644-1 Cleanrooms for Class 8. MERV 11 Filtration as a minimum, MERV 13 preferred.

4.12.4.3.8 Sleeves and Egresses

- Sleeves and/or egresses, vertical or horizontal shall be 4" diameter unless otherwise specified and shall penetrate the surface (floor or wall) 2-3". All sleeves/conduit ends shall reamed and outfitted with an insulated bushing.
- Conduits = (1) 4" per 75 cables.
- Basket Tray (if no drop ceiling) = per selected manufacturers loading specifications.
- Fire stopping shall adhere to local building and fire code requirements.
- If generator exists and supports Data Center/Server Room/MDF electrical circuits, HVAC system should be also be connected to the generator.

4.12.4.4 Cabling Standards

4.12.4.4.1 **For Data centers/Server Rooms/MDF please see**

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IM-MAN-0048 for more detailed specifications

4.12.4.4.2 Please note that current BMS locations requiring any additional cabling to the current installed infrastructure are to match the current installed infrastructure. All new and renovated areas will follow the new CAT6A guidelines were all cabling and copper feeds should be terminated on patch panels.


4.12.4.4.3 Open Bay Relay Racks

- **One (1) Rack is to be dedicated for fiber,dataswitch and analog gateways in VoIP applications typically the center rack.**
- **All racks shall consist of channel racks or 4 post racks with vertical wire managers and optional accessories (example: Ortronics Mighty Mo 20 rack system).**
- One (1) rack consisting of 48-port angled patch panels and wire managers not to occupy more then half of a rack).
- 2U wire minders will be installed at the top of each relay rack assembly and below each 2 angled patch panels. This will permit one wire minder above and below each pair of patch panels.
- Vertical wire management channels mounted between each relay rack assembly and at the end of end row.

4.12.4.4.4 18" – 24" wide ladder racking shall be mounted above all relay rack assemblies and/or cabinet rows to support cable routing into and within the Data Center/Server Room/MDF.

- Ladder racking shall provide access to all surrounding walls, allowing cable access from any part of the room.
- Installation shall comply with all local requirements.

4.12.4.4.5 If the Data Center/Server Room also serves as an

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MDF for the surrounding work areas, refer to additional information included in sections for Telecommunications Rooms and Horizontal Cabling.

4.12.4.4.6 **Vertical wire managers are permitted in two width options dependant on space availability. Standard is 12". For limited space 6" is permitted. Final design should be confirmed with Network/Hosting operations.**

4.12.4.5 Product Specifications for all new Data Center/Server Room/MDF

4.12.4.5.1 7' high channel rack or four post rack.

4.12.4.5.2 2u horizontal wire managers

4.12.4.5.3 2U 48-Port CAT 6A angled Patch Panels

4.12.4.5.4 300 Pair Wall Mount Blocks w/ legs (when needed)

4.12.4.5.5 Wire Trough w/ legs (for use with above)

4.12.4.5.6 D-Rings (cross-connect management)

4.12.4.5.7 **6" , 10": and 12" Vertical Management Channel per design**


4.12.4.5.8 **20A/30A PDUs (based on circuiting) outlet center with minimum 6ft cord**

4.12.5 Telecommunication Rooms (TR) Design Standard

4.12.5.1 Facility Standards

4.12.5.1.1 Telecommunications Room Intent

- Room shall be limited to providing support for voice and data communications cabling and equipment.
- No unrelated equipment shall be located in or pass through Tele/Data Room(s). This includes security equipment, facilities monitoring (BAS) equipment, central UPS equipment, electrical panels (unless dedicated to supporting TRs only), or other miscellaneous uses.

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- Room will not be used for storage, with the exception of a limited amount of voice and data patch cords and/or cross connect cable.

4.12.5.2 Number of TRs

4.12.5.2.1 Office Space/Lab Space

- A minimum of one Tele/Data Room per floor.
- Exact number and location should permit furthest cabling point to be within the 295' of TR based on an accessible cabling pathway. Cabling pathways may not always be in the most direct route and any additional routing lengths shall be included within this overall length measurement.
- TR should not support more than 200 workstations (drop locations).
- It is recommended that for office space (1) Tele/Data Room per 15-25K Square foot of usable space be allocated for in the space planning process.

4.12.5.2.2 Manufacturing/Warehouse Space

- Given the uniqueness of these environments, the number of TRs within these spaces should permit furthest cabling point to be within the 295' of TR based on an accessible cabling pathway. Cabling pathways may not always be in the most direct route and any additional routing lengths shall be considered in this overall length measurement.
- TR should not exceed more than 200 drop locations (workstations).


4.12.5.3 Relative location

4.12.5.3.1 TRs should be centrally located.

4.12.5.3.2 In multi-story facilities it is strongly encouraged to vertically align all TRs

4.12.5.4 Tele/Data Room Size

4.12.5.4.1 Size of Tele/Data Rooms: recommended 10' x 12'

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(120 sqft).

4.12.5.5 General Room Construction Elements

- 4.12.5.5.1 Room shall be painted in a light color to enhance lighting conditions.
- 4.12.5.5.2 Ceiling height shall be 10 ft. (12 ft. preferred). Drop ceiling is recommended but not required.
- 4.12.5.5.3 TRs will be equipped with one wall covered with a 3/4" (AC) Grade (fire rated) plywood or appropriately rated or painted backboard of at least 8' x 8' section – (black in color). Exposed side will be smooth. If reusing an existing backboard, contractor will remediate holes left from the removal of equipment to achieve the "smooth surface" requirement prior to repainting. (Attention not to paint over fire label)

4.12.5.6 Electrical Requirements

- 4.12.5.6.1 Circuits to be installed in room:
 - Six (6) dedicated 208V/30A circuits shall be mounted in a duplex receptacle located on the back side of each relay rack(s), 18" AFF. Use NEMA L6-30R receptacles unless otherwise directed. Please note that the circuit sizes indicated are intended for bidding purposes.
 - At lease one (1) 120V convenience outlet shall be located on each surrounding wall for tools and testing unless otherwise specified.
- 4.12.5.6.2 UPS support - The following are initial requirements based on generic specifications. Actual load requirements shall be determined based on the equipment loads for the intended for room. All equipment details shall be coordinated with the appropriate IT staff.
 - Where centralized UPS supports services in the building, all TRs in the building should be connected to the generator to support the circuits. Minimum run time should be 60 minutes at full load.

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- Where centralized UPS does not exist as defined above, switch/room UPS equipment will need to be acquired. Design objectives for room/switch UPS are as follows: (a) 30 min run time in each TR; (b) 60 min run time in each TR if VoIP applications exist.

4.12.5.6.3 Generator support


- Where backup generator exists and provides service beyond essential life safety support, all TRs in the building should be connected to the generator to support the circuits in 6.a.i and 6.a.ii above.
- Room lighting and air conditioning should also be considered for generator backup, as defined below.

4.12.5.6.4 Lighting support

- Minimum lighting requirements: 50 foot-candles (500lux) measure 3ft AFF.
- Lights should be positioned in front and in back of relay racks.
- One light in each TR should be configured with battery ballast for Emergency lighting.
- If installed lighting is not indirect, then tube guards shall be installed to ensure glass fragments are kept away from equipment in case of breakage.

4.12.5.7 Sleeves and Egresses

- 4.12.5.7.1 Sleeves and/or egresses, vertical or horizontal shall be 4" diameter unless otherwise specified and shall penetrate the surface (floor or wall) 2-3". All sleeves/conduit ends shall reamed and outfitted with an insulated bushing.
- 4.12.5.7.2 A minimum of (3) vertical sleeves shall be placed in each new Tele/Data Room.
- 4.12.5.7.3 At least (1) horizontal conduit shall be used to support inter-ties between adjacent Tele/Data Rooms.

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4.12.5.7.4 Horizontal Egresses:


- Conduits = (1) 4" per 100 cables.
- Basket Tray (if no drop ceiling) = per selected manufacturers loading specifications.
- Fire stopping shall adhere to local building and fire code requirements.

4.12.5.8 Environmental/HVAC

- 4.12.5.8.1 Provide HVAC that will maintain continuous and dedicated environmental control (24 hours per day, 365 days per year) for each TR. Maintain positive pressure with a minimum of one air change per hour in the TR.
- 4.12.5.8.2 Dissipate the heat generated by active devices. For the purposes of load planning, HVAC for each TR should be configured to reject 24KBTU/hour of heat.
- 4.12.5.8.3 Provided HVAC should maintain a temperature range specified in ASHRAE Technical Committee 9.9 , recommended 64.4°F to 80.6°F. The humidity range should be 45% to 55% relative humidity.
- 4.12.5.8.4 If generator exists and supports TR electrical circuits, HVAC system should be connected to generator as well.

4.12.5.9 Cabling Standards

- 4.12.5.9.1 Please note that current BMS locations requiring any additional cabling to the current installed infrastructure are to match the current installed infrastructure. All new and renovated areas will follow the new CAT 6A guidelines were all cabling and copper feeds should be terminated on patch panels.
- 4.12.5.9.2 Rack assignment
- One (1) rack dedicated for fiberpanels,dataswitch and analog gateways in VoIP applications typically the center rack .
 - One (1) rack for every (6) 48-port angled

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patch panels, permits 2U patch panels and wire minders (occupies half of a rack).

- 2u wire minders will be installed at the top of each relay rack assembly and below each 2 angled patch panels. This will permit one wire minder above and below each pair of patch panels.

4.12.5.9.3 Vertical wire management channels mounted between each relay rack assembly and at the end of end row.

4.12.5.9.4 18" wide ladder racking shall be mounted above rack assemblies to support cable routing. Ladder racking shall provide access to all surrounding walls, allowing cable access from any part of the room.

4.12.5.9.5 Surface multioutlet raceway, shall be vertically mounted on the rear of each rack.

4.12.5.10 Tele/Data Room Product Description

4.12.5.10.1 7' high channel rack or four post rack.

4.12.5.10.2 2u horizontal wire managers

4.12.5.10.3 2U 48-Port CAT 6A angled Patch Panels

4.12.5.10.4 300 Pair Wall Mount Blocks w/ legs (when needed)

4.12.5.10.5 Wire Trough w/ legs (for use with above)

4.12.5.10.6 D-Rings (cross-connect management)


4.12.5.10.7 6" and 10" Vertical Management **Channel**

4.12.5.10.8 **20A/30A PDUs (based on circuiting) outlet center with minimum 6ft cord**

4.12.6 Horizontal Cabling Standards

4.12.6.1 Facilities Standards - Workstation Pathways

4.12.6.1.1 All hard wall drop locations shall be equipped with a conduit and backbox from the identified wall mount location to the above ceiling space in order to facilitate cable routing to each wall mount location.

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4.12.6.1.2 The minimum trade size conduit that will be used to feed any (1) backbox or wall box location (workstation) shall be no smaller than 1" in diameter.

4.12.6.1.3 The minimum trade size conduit/sleeve that shall be used to feed any modular furniture grouping shall be no smaller than 2" in diameter. Exact number or conduits/sleeves per cubicle group, will be dependent on the number or cubicles and/or drop locations within a particular furniture grouping.


4.12.6.2 Cabling Standards - Workstation Configuration and Hardware

4.12.6.2.1 Cabling efforts described within are based on both new cabling installation as well as cabling infrastructure upgrades.

- Decision factors for partial upgrades verses entire system upgrades should be based upon the 50% mark. If more than 50% of the entire cabling system is being considered for upgrade – then entire system should be completed.
- The following descriptions shall be considered as minimum recommendations, but final installation shall comply with the most stringent codes/standards or cabling practices.
- For smaller installations – If space is available within an existing panel – cabling should match installed system. If new termination hardware is necessary them cabling should follow these specifications.

4.12.6.2.2 Outlet configuration – Each workstation outlet or drop location shall be configured as herein indicated. This configuration shall be considered as the BMS standard drop package, additional configurations may be necessary to support special circumstances. However, these shall be identified on a case by case basis.

- Two (2) (white) color data Jacks 6A Jacks

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- Jacks shall be terminated using a (white) Berk-Tek LANmark XTP Category 6A 4-pair UTP or Superior Essex 10G XP U/UTP cable or Superior Essex 10G XP U/UTP cable – appropriately rated for the intended environment. (based on existing conditions and/or market price)

4.12.6.2.3 Voice Only Applications


- One (1) Category 6A Jack
- Jacks shall be terminated using a (white) Berk-Tek LANmark XTP Category 6A 4-pair UTP or Superior Essex 10G XP U/UTP cable – appropriately rated for the intended environment. (based on existing conditions and/or market price)

4.12.6.2.4 Mounting Devices and Labeling

- Mounting devices, whether intended for wall or furniture, shall accommodate a minimum of (4) jack positions.
- All mounting devices shall have labeling windows for identifying both station and port positions.
- Mounting device color shall be based on its intended locations: (a) Wall mount locations shall be neutral in color as to blend seamlessly into its surroundings. (b) Faceplates/Bezels to be used in modular furniture or demountable wall locations shall be color match for the intended system.
- Icon buttons designating voice and data locations shall be used on all workstation jacks and color coded for its intended application.

4.12.6.2.5 Location/Positioning/Quantity


- The number of outlet or drop locations per area shall be based on the intention of the area.

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- Cubicles: (I) Two (2) drop locations per cubicle. (II) It is strongly encouraged that all terminations be located within side panels and not in center spine (main spine), as not to reduce fill potential of the center spine. If furniture system only supports center spine termination – then channel fill capacity should be calculated prior to installation to ensure it does not exceed 40-50%. (III) Final mounting location shall be coordinated with both facilities and IT groups to ensure adequate support for intended equipment as well as to avoid tripping or kicking hazards.
- Hard wall offices/Conference Rooms: (I) Two (2) drop locations per room. (II) The Locations should be placed on opposing walls to ensure maximum flexibility within room. (III) Wall mount jacks locations shall be mounted 18" AFF.
- The minimum trade size conduit that will be used to feed any (1) backbox or wall box location (workstation) shall be no smaller than 1" in diameter.
- The minimum trade size conduit/sleeve that shall be used to feed any modular furniture grouping shall be no smaller than 2" in diameter. Exact number or conduits/sleeves per cubicle group, will be dependent on the number or cubicles and/or drop locations within a particular furniture grouping.

4.12.6.2.6 Installation and Termination Requirements:

- 18" of slack shall provided at each workstation area whether left behind the wall or within the modular furniture.
- Twist patterns shall be maintained within 1/2" from the termination point (IDC). 0" for Atlas X1 outlets.

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- Installation shall comply with all pulling tension and bend radius requirements.
- Cabling jacket shall be maintained as close as possible to the termination point (IDC) (no more than 1" from). 0" for Atlas X1 outlets.
- All termination hardware shall be terminated using the T568B wiring scheme (code reference – ANSI/TIA/EIA-568-C.0).
- Cables shall be neatly bundled throughout the entire Tele/Data Room using loosely strapped Velcro. Plastic ties will NOT be permitted at any point of the project – NO EXCEPTIONS!

4.12.6.2.7 Hardware specifications


- Workstation - Data Products
- Workstation – Mounting Products
 - Furniture Adapters/Bezel Ortronics (P/N for furniture adapters shall be determined by the type of furniture).

4.12.6.3 Cabling Standards - Horizontal Cabling System Pathways

4.12.6.3.1 Bristol-Myers Squibb has identified two main sources for cable routing in the horizontal system. These are not the only systems only for installation, however they are the PREFERRED method: (a) Cable Tray, (b) Basket Tray. For locations where space is tight or spans between cable tray/basket tray J Hooks for limited runs are permitted.

4.12.6.3.2 For complete installation guidelines and procedures please refer to Data Centers.

4.12.6.3.3 In multi-tenant (shared/common) space all communications cabling (copper/fiber) shall be installed in raceway system. Refer to BMS-ENG-DS-2015: Design Standard for Power Distribution for details. (1) Flexible conduit shall not be used in runs longer than 10ft. (2) Conduit installation shall comply with all local codes and

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requirements.

4.12.7 Intra-Building (Inside) Backbone Cabling System


4.12.7.1 Cabling Standards/Guidelines

4.12.7.1.1 Fiber Optic Backbone (Data) – The fiber optic backbone cabling system is intended to provide a cabling pathway from each Tele/Data Room to a main distribution point within a particular facility to support data communications requirements. Corning fiber and hardware is preferred.

- Cable Type – Each TR shall be equipped with both 50um OM3 multimode and single-mode fiber to support current and future networking requirements.
 - Preferred Cabling – Intra-building Interlocking Armored (appropriately fire-rated).
 - Hybrid cables (multimode and single-mode in the same jacketing) are considered acceptable.
- Strand Count (in multiples of 12 strands, i.e. 12-24-36, etc.) as per design.
 - Strands of 50/125 Multimode OM3/OM4 Fiber armored plenum.
 - Strands of Singlemode OS2 Fiber armored.
- Connector:
 - Multimode: (a) SC Type Multimode Connector – Beige. (b) No crimp-on in process areas. Uni-cam is acceptable in office areas for short runs and for facility applications.
 - Single-mode: (a) SC Type Single-mode Connector – Blue. (b) No crimp-on in process areas. Uni-cam is acceptable in office areas for short runs and facility applications.
- Fusion Splice Pigtail and Splice Tray:


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- Multimode: (a) SC Type Multimode Fusion Splice Pigtail Connector
- Singlemode: (a) SC Type Single-mode Fusion Splice Pigtail Connector
- 12port-Fiber Molded Splice Tray
- Hardware:
 - Multimode and single-mode fibers shall be terminated in separate connector housings to ensure clearly defined termination areas for either.
 - All termination hardware shall be rack mountable (space permitting).
 - Connector housing shall accommodate a minimum of 72 duplex SC connectors or (144 strands).
- Pathways
 - Primary and secondary backbone runs will be required from each TR. Strand counts for secondary run shall mirror the primary (in multiples of 12 strands, i.e. 12-24-36, etc.). The Primary cabling runs are considered the main cabling pathway from a TR to the central distribution point (Data Center, Computer or Equipment Room, etc.). The secondary cabling pathways provide redundant routing back to the same central distribution area, either through a TR located on the same floor or directly using a diverse cabling pathway.
 - Primary and secondary runs shall be fully diverse routes (paths permitting).
 - Fiber optic cabling shall be distributed through facility in a dedicated pathway (Tray or Conduit) or appropriately divided if containing multiple cable types.
 - If non-armored cabling is used, then cabling shall be distributed in an Orange

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or white inner-duct system to ensure high visibility; minimum OD of 2”.


- In multi-tenant (shared/common) space all communications cabling (copper/fiber) shall be installed in a dedicated (not shared with other tenants) raceway system. Refer to BMS-ENG-DS-2015: Design Standard for Power Distribution for details. (a) Flexible conduit shall not be used in runs longer than 10ft. (b) Conduit installation shall comply with all applicable local/national codes and requirements.
- Product Specifications
 - Intra-Building Fiber Product
 - 4u Rack Mount Closet Connector Housing (CCH) - Corning Cable CCH-04UMultimode Duplex SC Connector Panel (6 SC) - Corning Cable CCH-CP12-91
 - Single-mode Duplex SC Connector Panel (6 SC) - Corning Cable CCH-CP12-59
 - 4RU Rack Mount Fiber Panel - Leviton 1000i 5R4UM-F12
 - Multimode Duplex LC Connector Panel (12 LC) – Leviton 5F100-2QL
 - Single-mode Duplex LC Connector Panel (12 LC) – Leviton 5F100-2LL
 - Cable
 - Plenum(CMP) - 12 Strand Multimode OM3 Armor-Tek Interlocking Armored Fiber (50/125) – Berk-Tek PDPK012EB3010/25-I/O-C4C5(AQU)
 - Plenum(CMP) - 12 Strand Single-mode OS2 Armor-Tek Interlocking Armored Fiber – Berk-Tek PDPK012AB0707-I/O-C4C5(YEL)

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- Additional strand counts, glass types and CM ratings available
- Plenum(CMP) - 12 Strand Multimode OM3/OM4 Armor-Tek Interlocking Armored Fiber (50/125)
- Plenum(CMP) - 12 Strand Single-mode OS2 Armor-Tek Interlocking Armored Fiber –

4.12.7.1.2 Copper Backbone (Voice) – The copper (UTP) backbone cabling system is intended to provide a cabling pathway from each Tele/Data Room to a main cross-connect area (MDF) within a particular facility to support voice requirements.

- Cable Type – Each TR shall be equipped with multi-pair Category 3 (UTP) cable(s) to support voice requirements within each Tele/Data Rooms servicing area. Cabling shall be appropriately fire-rated for the intended installation and application for which it will be used.
- Pair Count
 - Backbone pair counts shall be based on providing (2) pairs of backbone cabling per workstation area (user) plus an additional 25%, final pair count shall be rounded up to the nearest 100th pair.
 - A minimum of 100 pair shall be provided to each Tele/Data Room for Tele/Data Rooms supporting less than 50 users.
 - It is recommended that 100-pair or higher cabling bundles be used to configure all backbone pair counts.
- VoIP copper pair counts
 - Backbone pair counts shall be based on owners discretion.
 - A minimum of 25 pair shall be provided to each Tele/Data Room.

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- Hardware
 - Terminations in each Tele/Data Room shall be made on 300-pair wiring blocks. All wiring blocks shall be equipped with stand-off legs to permit cabling to be routed from behind.
 - C5 wiring clips shall be used for all backbone terminations, unless otherwise required for Multi-pair cabling.
 - Wiring troughs shall be provided between all wiring blocks. Trough shall also be equipped with stand-off legs.
- VoIP Wardware
 - Copper feeds should be terminated on patch panels in middle rack under the fiber chamber.
- Pathways
 - It is strongly recommended that Backbone (riser) cabling is not distributed through other cabling pathways. If unavoidable, then multi-pair cabling shall be placed at the bottom of pathway to ensure it does not lie on top of other cabling medium.
 - When distributed through vertical pathways, cabling contractor shall secure cabling per local codes and requirements and shall adhere to all manufacturer's installation recommendations.
- Copper Backbone - Voice Products
 - 300 Pair Wall Mount Blocks w/ legs (example: Leviton 41AB2-1F5)
 - Wire Trough w/ legs (example: Leviton 41A10-HCM)
 - Category 3 UTP: Available in 25, 50, 100, 200 & 300-pair counts, CMR or CMP


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4.12.8.1 OSP cabling, also referred to as Inter-Building Backbone is a cabling pathway distributed in a campus environment to interconnect outlying buildings to a common telecommunications network.

4.12.8.2 Facility Standards

4.12.8.2.1 Pathways – Construction Guidelines pertaining to communication cabling systems. The following are the recommended practices for the installation of Outside Plant Cabling systems. They are based on best practices and system protection. The preferred pathway in the outside plant is conduit, which has been chosen for its overall protective properties. Alternative pathways include the use of aerial cabling when conduit installation is not practicable. To ensure the integrity of the cabling system the use of direct buried cabling is considered unacceptable.

- Underground conduits are the preferred pathway for the OSP environment for its protective properties.
 - Size: Minimum of 4" Conduit
 - Capacity: Design conduits so that initial fill does not exceed 50% (permits future expansion).
 - Inner-duct: where applicable install fiber in an appropriately rated inner-duct.
 - Underground: Minimum depth of 24" .
 - Tag/Label all conduit entrances with "TO" and "FROM" locations.
 - Distances between pull points shall not exceed 600ft.
- Aerial Cabling
 - Aerial entrances – distance from last pole to the building should not exceed 100 ft.
 - Suspension/clearances (a) Power at pole – 40" below power supply service; (b) Power at mid span – 12" below power

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supply service; (c) Power at building attachments – 12” Vertically & 4” Horizontally.

4.12.8.2.2 Access Points

- Man-Holes (maintenance holes)
 - NEVER use joint use Man-holes (communications/electrical), if unavoidable ensure separate entry points for safety.
 - Conduit entry points in Man-holes should be made at opposite ends to ensure cleaner routing and to maximize working clearance in the center of man-hole.
 - Corrosion resistant conduit should be used.
 - All hardware shall be galvanized (corrosion resistant).
 - All Man-Holes covers shall appropriately identify services within.
- Pull Box (hand holes) – Sizing and considerations
 - Width and depth shall be adequately sized and for fishing, pulling and looping cabling.
 - Length must be 12 times the diameter of the largest conduit. In some cases a box length of 16 times the diameter of the largest conduit may be appropriate.


4.12.8.3 Cabling Standards

4.12.8.3.1 Inter-building Backbone - The fiber optic/copper backbone cabling system that is intended to provide a common network or telecommunications infrastructure between multiple buildings in a campus environment. For data environments, fiber optic cabling is typically distributed from each outlying building to one central point (Campus Distributor/Distribution

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Point). This is typically done through new or existing conduit pathways or via direct-buried/aerial cabling. This type of network may require more hierarchical levels to be put in place. A detail networking architecture must be provided prior to cabling design.

- **Design Factors**
 - Detailed review of networking architecture and cabling requirements.
 - Thorough review of existing facilities and pathways: (a) Conduits; (b) Man-Holes (Maintenance Holes); (c) Cable Vaults; (d) Point of Presence (POP); (e) Entrance Facility (size and location).
 - Survey and determine the requirements for each individual facility. (a) Entrance facility (I) Access / Cable routes / POP (Point of Presence). (II) Termination space. (III) Clearance. (b) Physical size and capacity.
 - Complete understanding of all local codes and requirements.
- **Networking Topology**
 - Star/Hierarchical Star – Cabling topology that connects all outlying buildings (facilities) to one central distribution point either directly or through an Intermediate Building (connection point).
 - Physical Ring – Cabling is distributed to each building in a ring fashion however logically it still functions as a star. Primary reasons for using a physical ring: (a) Using existing conduit pathways. (b) Redundant cabling paths.
- **Cable Type** – Many factors must be determined prior to finalizing cabling type, such as; intended pathways (underground, direct buried, or aerial), environment and

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application. Indoor/Outdoor fiber optic cabling (Berk-Tek Adventum or Corning Freedom or ALTOS) is typical preferred because of its advantages of being used in mixed environments.

- Strand count – Stand count shall be based on the following requirements:
 - Building size.
 - Number of Tele/Data Rooms.
 - Networking Architecture
 - Final strand count shall be based by IT and Facilities overall requirements and shall be coordinate with each group.
- Fusion Splice Pigtail:
 - Multimode: (a) LC Type Multimode Fusion Splice Pigtail Connector - Aqua –
 - Single-mode: (a) LC Type Single-mode Fusion Splice Pigtail Connector – Blue-
 - 12port-Fiber Molded Splice Tray
- Splicing
 - OSP splice should be avoided wherever possible, some conditions may exist which require OSP splicing to occur: (a) Plant layout. (b) Overall length. (c) Transitions between cable types.
 - Fusion splicing is the preferred method for splicing OSP cabling.
- Hardware – All Fiber OSP cabling can be either Berk-Tek or Corning and hardware shall be Leviton or Corning, to correspond with the intra-building cabling and components.
- Carrier Redundancy – For those sites where external network services (Voice and/or Data) are considered essential to the business, redundant Network Access Points

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(NAPs) are to be provisioned.


- The following is required to help guarantee diverse paths and eliminate the local loop as a single point of failure. The local loop is a name that refers to the circuit(s) that runs between the customer site and the Local Exchange Carriers (LEC's) Central Office (CO). (a) Diverse pathways (i.e., conduits) should be installed between the BMS network equipment (as necessary), (i.e. router, switch, PBX, ACD, etc) and the sites Demarcation point(s). (b) Diverse pathways (i.e., conduits) must also be installed between the Demarcation point(s) and the circuit entry points into the BMS site. (c) Two diverse entry points into the BMS site are to be provided. (d) Two physically and geographically diverse routes between the BMS site and multiple physically and geographically diverse Local Exchange Carriers, Central Offices are to be provisioned.
- Multiple long-haul carriers will be required to assure similar Point of Presence (POP), route and path diversity for the long-haul circuits linking the LEC's local access networks to the long-haul networks.
- Discussions should be held with all the Local Exchange Carriers, (LECs) and long-haul carriers to ensure diverse paths exist and that no single points of failure have been introduced into the network.

4.12.9 Labeling Standards

4.12.9.1 Cabling Standards

4.12.9.1.1 Labeling requirements:

- Identify and permanently label all station cables, faceplates and panel ports with the

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identified numbering scheme which will include, the corresponding Tele/Data Room, Rack, Panel, and Port Position.

- Cables shall be labeled 6" behind each termination point.
- Workstation outlets at the top of each faceplate/surface mount box using an electronically generated labeling system.
- All racks, panels and/or termination blocks shall be labeled appropriately.

4.12.9.1.2 Handwritten labels as well as "Brother P Touch" or similar labeling system are considered unacceptable, laser printable paper stock is however an acceptable medium for printing labels.

4.12.9.1.3 Identification Requirements:

- Workstation Locations/Ports – shall be identified by using either corresponding TR termination point – which will include Room, Rack, Panel and Port.
- Relay racks within each Tele/Data Room will be assigned a numeric position, which will start with at position "1" (rack adjacent to wall). For TRs with multiple rack rows, position "1" shall be located in the row nearest to the entrance.
- Panels within each rack position will be identified alphabetically from top to bottom, starting at position "A" (top panel). All termination hardware will assigned a panel position, wire management hardware between termination panels will not be include in identification order.
- A floor plan identifying all drop locations with a Tele/Data Rooms serving area shall be hung in each TR.

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4.12.9.1.4 Labeling Details

Figure 4.1 – Workstation Labeling Detail

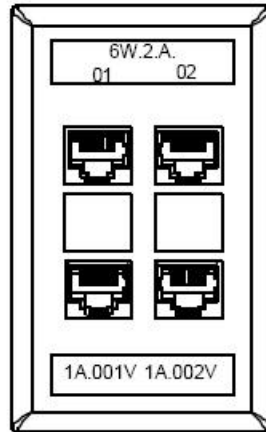


Figure 4.2 – Patch Panel Labeling Detail

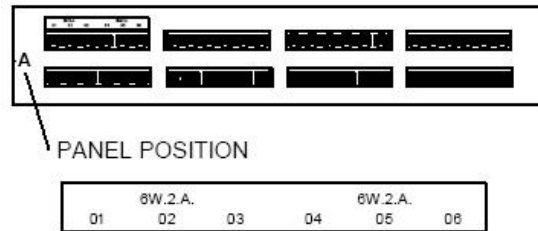
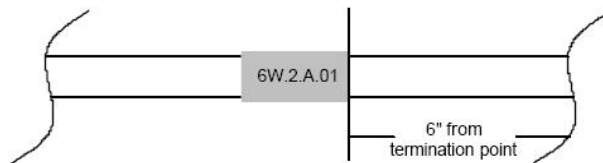


Figure 4.3 – Cable Labeling Detail




4.12.10 Patching Standards

4.12.10.1 Cabling Standards

4.12.10.1.1 Patch cord requirements

- Copper Cords
 - All copper patch cords shall comply with TIA/EIA-568-C.0 distance limitations, and not exceed 5 meters (15 ft.) or will not extend the permanent link beyond 100


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meters.

- All patch cords shall meet or exceed the rating of the permanent link cabling, i.e. Category 6A, etc.
- All patch cords shall be factory tested prior to installation.
- Only appropriate length (3', 5', 7', 10' & 15') patch cords shall be purchased (i.e. Leviton Cat. 6A Patch Cords 6AS10-XX*). Ortronics is acceptable for CAT6A.
- Final quantities and cable lengths shall be coordinated with the appropriate IT staff.
- Fiber Cords
 - Patch cord core sizes shall match the core diameter of the cabling system (i.e., 50 or 62.5 micron).
 - Appropriate length (1, 3, 5, 7 and 10 meters) patch cords shall be purchased (i.e. Leviton or Corning is acceptable).
 - Final quantities and cable lengths shall be coordinated with the appropriate IT staff.

4.12.10.1.2 Patch cord Installation requirements

- All patch cords shall be installed in a neat and orderly manner.
- All patch cords installed in Tele/Data Rooms shall be threaded through wire minders or similar cable management systems.
- No patch cords shall be installed in such a way that the cords become twisted, knotted or tangled.
- No patch cords shall be installed in Tele/Data Rooms in such a way that it limits access to network equipment.
- Only patch cords of the appropriate length (3', 5', 7', 10' & 15') shall be installed.
- Various lengths of patch cords shall be

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installed in Tele/Data Rooms in a "made to fit" fashion to maintain a neat and orderly installation, examples are provided below.

- Excessively long or short patch cords shall not be installed in Tele/Data Rooms.
- All patch cords shall be neatly bundled throughout the entire Tele/Data Room using loosely strapped Velcro. Plastic ties will NOT be permitted at any point of the project – NO EXCEPTIONS!!!
- All unnecessary patch cords shall be removed.

4.12.10.1.3 Patch Cord Routing

- Determine cabling path
 - Overall rack path - side by side racks (switch is next to panel): (a) Left side panel ports go to right side switch ports; (b) Right side panel ports go to left side switch ports; (c) Exceptions include unique patch panel ports that need to cross (should cross at earliest available point).
 - Outside cables should run upward, then through top wire minder, then downward, then horizontally through wire minder directly above switch.
 - Inside cables should run downward, then directly into switch.


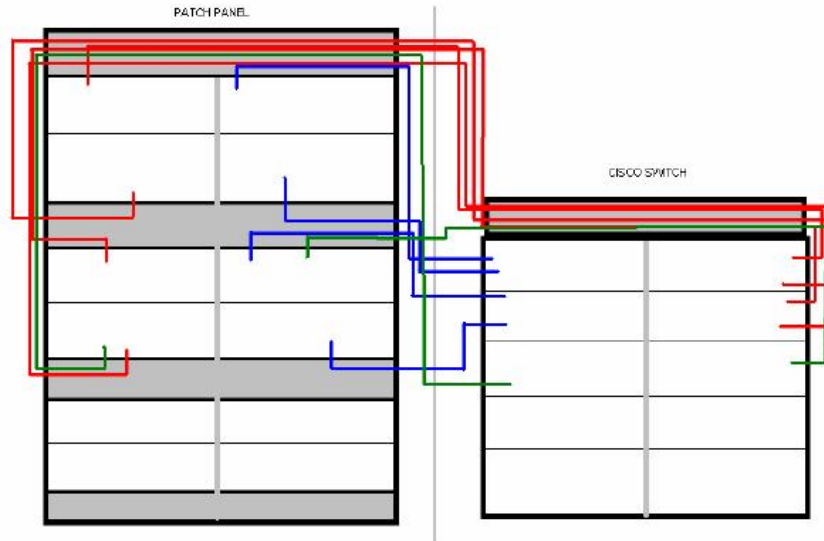
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Figure 4.4 – Side by Side Rack Detail



- Overall rack path - all in one rack (switch is below panel).
 - Left side panel ports go to left side switch ports.
 - Right side panel ports got to right side switch ports.
 - Almost all cables run directly downward and into switch.
 - Exceptions include unique patch panel ports that need to cross (should go upward, then through top wire minder, then down to far side of switch). No cables should cross directly above switch.


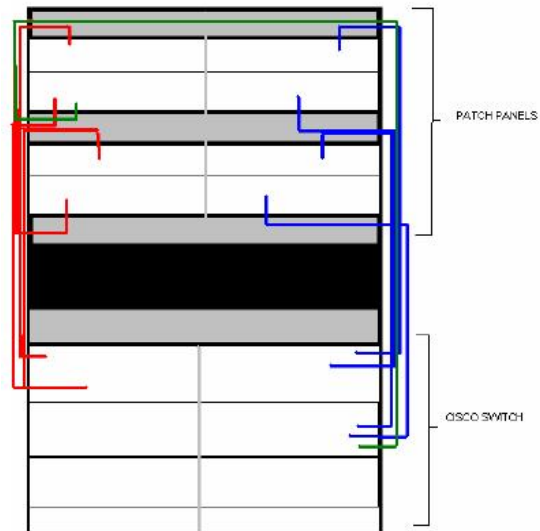
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Figure 4.5 – All In One Rack Detail



- 48-port patch panels and horizontal wire minders (rows)
 - Cables on top left of a panel should run up and left.
 - Cables on top right of a panel should run up and right.
 - Cables on bottom left of a panel should run down and left.
 - Cables on bottom right of a panel should run down and right.
 - In side by side racks, cables in highest wire minder should all run in one direction toward switch.
 - Cables should enter into minder in pairs – Ports 1 & 2 go through slot 1, Ports 3 & 4 go through slot 2, etc.
- 48-port patch panels and vertical wire minders (columns)
 - Cables on top row of panel running up should first tuck downward.
 - Cables on top row of a panel running down should go straight down.


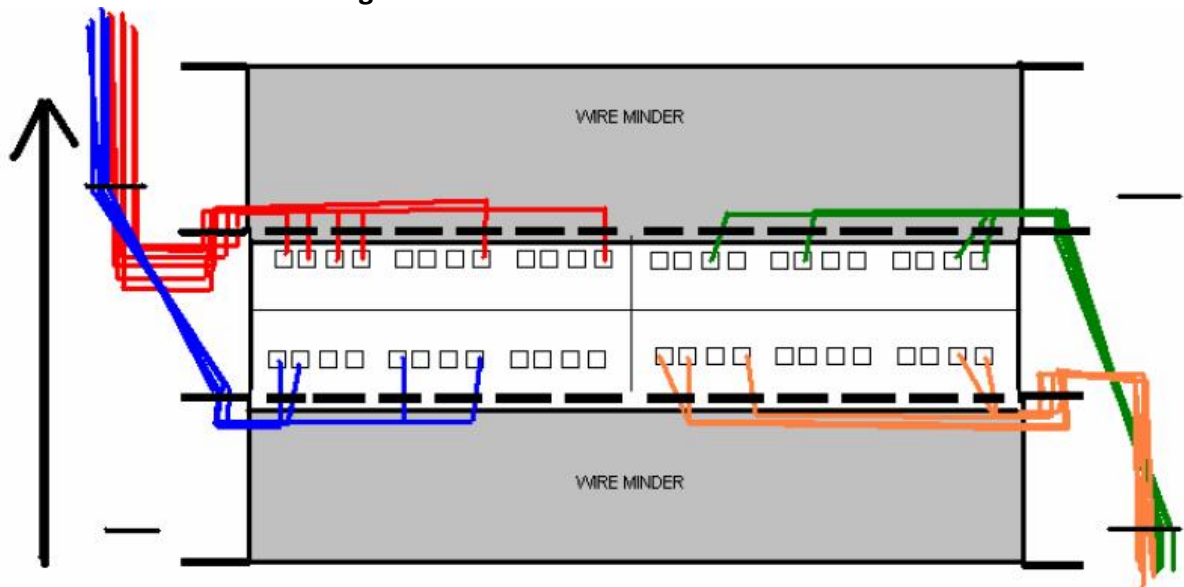
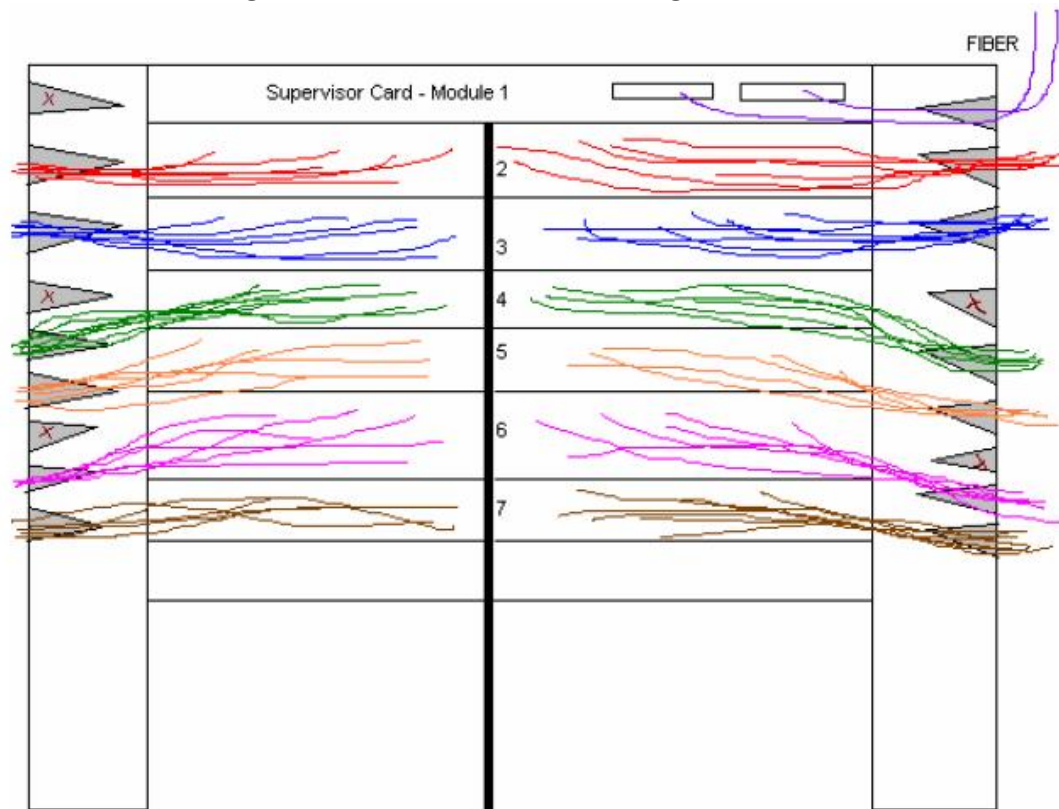
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Figure 4.6 – 48-Port Panel Detail



- At-The-Switch Patching Connections
 - Use the 2nd and 3rd minder for modules two and three.
 - 5th and 6th minder for modules four and five.
 - 8th and 9th minder for modules six and seven.
 - Continue as needed, skipping every the 1st and every 3rd minder.
 - ALL CABLES FROM LEFT should go to ports 1-24.
 - ALL CABLES FROM RIGHT should go to ports 25-48.

Figure 4.7 – At-The-Switch Patching Detail




4.12.11 Documentation Requirements

4.12.11.1 The purpose of this section is to provide general guidance to BMS employees, cabling vendors and/or consultants as to the documentation requirements for cabling projects. These documents are to be supplied electronically and if requested in hardcopy. Vendors shall coordinate all software requirements with BMS or its representative prior to project/documentation completion.

4.12.11.2 Cabling Standards

4.12.11.2.1 Drawings and diagrams

- Proposed arrangement and "as-built" diagrams shall be submitted for approval prior the job, and for "As-Built" for records at the end of the job. Record drawings shall be supplied electronically on CD, submittal of drawings on any other medium shall be approved by BMS or its representative. Refer


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to BMS-ENG-DS-1300: Design Standard for CADD.

- Fiber/Copper Testing Documentation shall be provided. Testing documentation may not be turned over with any recorded failures. Vendor shall coordinate an acceptable file format for all testing documentation. If vendor specific software is required to view test results, it shall be supplied at the same time as the test results.
- Documentation Turnover - All drawings shall be provided in both electronic and hardcopy formats. Vendor shall be responsible for providing a floor plan diagram in each Tele/Data Room showing its corresponding workstation areas.
- Tele/Data Room (technology related facilities) Documentation – these requirements shall also apply to all other technology related facilities such as, MDFs, Computer Rooms, PBX Rooms, Entrance Facilities, etc...

4.12.11.2.2 Required Drawings/Diagrams

- TR Layout – detailing rack/cabinet placement, cable trays, backboards, vertical/horizontal sleeves (egresses), equipment/hardware positioning, general notes, panel schedules and labeling as necessary. Rack or backboard elevations may be incorporated into this diagram if spacing permits.
- Rack Elevations – depicts exact placement of termination, cable management and electronic hardware positioning. Should also include power strip positioning if required.
- Electrical Elevations – shows number and type of electrical receptacles that are required in each rack as well as the general place for each. Ground requirements shall also be specified within the document.

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4.12.11.2.3 Digital Photo Requirements – photos shall be taken of the following items. Refer to site regulations for applicable permit for pictures.

- Cable/Basket Trays – visual reference for fill capacity at end of project, cable routing methodology, and media separation (copper/fiber).
- Egresses – Fill ratios, transitions, and cable placement.
- Rack elevations – front and rear rack elevations, preferably with equipment installed.
- All photos shall be submitted electronically, vendor shall work with BMS or its agent to determine an acceptable format.

4.12.11.3 Horizontal Cabling Infrastructure Drawings/Diagrams


4.12.11.3.1 Required Drawings/Diagrams

- Floor Plan – Communications/Electrical floor plan detailing workstation areas locations that are serviced by each Tele/Data Room. Plan shall also include the identification scheme used to label each drop location and the type of cabling to each workstation.
- Workstation Cross-Reference Spreadsheet – this spreadsheet cross-references the labeling scheme assigned to each drop package with the corresponding room/cubicle number assigned to that specific area.
- Workstation Labeling and Package Detail – this diagram will detail the different types of workstation outlets configurations as well as provide guidance for labeling.

4.12.11.4 Backbone Cabling Infrastructure Drawings/Diagrams

4.12.11.4.1 Required Drawings/Diagrams

- Fiber Optic (Data) Backbone Single-Line Diagrams – The fiber optic single line diagram


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is intended to provide general backbone information such as path, type of fiber, number of strands, termination areas, “From” and “To” information, and distance information.

- **Copper (Voice) Backbone Single-Line Diagrams** – The copper single line diagram is intended to depict general voice path information through a particular facility. Diagrams will provide information pertaining to; path, type of cabling, number of pairs (UTP cabling), and “From” and “To” information.
- **Conduit/Sleeve Diagrams** – This diagram is used to depict the number of transitions points or egresses (horizontal or vertical) required on each floor or within each Tele/Data Room. Also included within this diagram will be any required quantities of conduit that will be used to support the backbone cabling infrastructure.
- **Innerduct Diagrams** – this diagram will provide size and quantity information pertaining to the required innerduct pathways between areas. Innerduct is typically required for all fiber installations, however, cabling vendor shall coordinate all innerduct requirements with BMS or its agent.

4.12.11.4.2 Digital Photo Requirements – photos shall be taken of the following items. Refer to site regulations for applicable permit for pictures.

- **Cable/Basket Trays** – visual reference for fill capacity at end of project, cable routing methodology, and media separation (copper/fiber).
- **Vertical Sleeves** – Fill ratios, transitions, and cable placement.
- All photos shall be submitted electronically,

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vendor shall work with BMS or its agent to determine an acceptable format.

4.12.11.5 OSP Backbone Infrastructure Drawings/Diagrams

4.12.11.5.1 Required Drawings/Diagrams

- Site Plan – shows topical view of site (campus), building orientation, parking facilities, and other land marks.
- OSP Conduit diagrams – shows conduit pathways throughout campus, and provide distances, access points, manholes and will also provide general service information such as whether it contains electrical or communications (Copper/Fiber) cabling.
- OSP Fiber Design Plan – shows the general fiber path information such as “From” and “To” locations, strands, and path identification.
- OPS Fiber Distribution System – this diagram will show termination areas for fiber landing in each building, distribution methods, as well as the secondary level backbones within each building.
- Manhole Butterfly diagrams – this diagram will depict conduits and services entering each manhole location.


4.12.11.5.2 Digital Photo Requirements – photos shall be taken of the following items. Refer to site regulations for applicable permit for pictures.

- Photos of East, West, North and South walls locations.
- Current equipment conduits.
- Working clearances within each manhole.

4.12.11.6 Data Center (Computer Room) Drawings/Diagrams

4.12.11.6.1 Required Drawings/Diagrams

- Floor Plan – Communications/Electrical floor plan detailing cabinet and rack locations as

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well as other facility related equipment (PDUs, HVAC).

- Cabling/Package Distribution – Copper and fiber optic cabling distributed through out room (termination areas and package locations).
- Panel Schedules – provides detailed “From” and “TO” locations for all copper and fiber optical cabling within this facility.
- Cable/Basket Tray Layout – depicts tray location and cabling routing within this facility.
- Rack and Cabinet Elevations – depicts cabling hardware and equipment placement within each cabinet or rack location. Should include electrical requirements such as power strip or receptacle placement on or within racks or cabinets.


4.12.11.6.2 Digital Photo Requirements – photos shall be taken of the following items. Refer to site regulations for applicable permit for pictures.

- Cable/Basket Trays – visual reference for fill capacity at end of project, cable routing methodology, and media separation (copper/fiber).
- Horizontal Sleeves/Egresses – Fill ratios, transitions, and cable placement.
- All photos shall be submitted electronically, vendor shall work with BMS or its agent to determine an acceptable format.

4.12.11.7 Testing Documentation

4.12.11.7.1 A final copy of all tests reports (copper and fiber) will be provided to BMS in electronic format and in hardcopy.

4.12.11.7.2 Acceptable formats shall be MS Word, MS Excel or MS Access format. If private vendor software is required to view test results, the software shall

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be provided to BMS during documentation turnover.


- 4.12.11.7.3 All test results shall comply with manufacturers warranty requirements for each specified manufacturers' Extended Warranty Program. Reports shall include the data on all testing parameters as specified within the TIA/EIA standard documents for compliance testing structured cabling systems.

4.12.12 Testing Requirements

- 4.12.12.1 The purpose of this section is to provide general guidance to BMS employees, cabling vendors and/or consultants as to the testing and warranty requirements for all cabling projects. These requirements are based on industry standards and manufacturer's general recommendations. In addition to the following testing requirements, cabling contractor shall fulfill any additional testing that may be required under the selected manufacturer(s) warranty program as specified in this document. All cables must be fully tested and compliant with current Industry standards and manufacturers requirements. No MARGINAL PASSES will be accepted. On-going visual inspections will be performed during construction by BMS and/or its agent. All work done by the cabling contractor shall be performed in a high quality manner and the overall appearance shall be clean, neat and orderly.


4.12.12.2 Cabling Standards

- 4.12.12.2.1 Fiber Optic Cabling Requirements- Contractor shall test 100% of all fiber optic cabling. This Testing will only be considered valid after all installation activities (termination and mounting in the distribution panel) have been completed. Testing shall conform to the requirements and conditions as specified in: TIA/EIA-568-C.3; TIA-526-14A, for Multimode Fiber; TIA-526-7, for Single-mode Fiber.
- End-to-End Attenuation - Fiber shall be tested using an OTDR or an appropriately rated power meter at both operating wavelengths for the given fiber type: Multimode 850 and 1300nm; Single-Mode

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1310 and 1550nm. Attenuation testing is only required to be measured and documented in one direction. Loss specifications for either system are as follows:

- Multimode: 3.5dB/km of loss, measured at 850nm, plus 0.75dB per mated pair; 1.5dB/km of loss, measured at 1300nm, plus 0.75dB per mated pair.
- Single-mode - Premise Cabling: 1.0dB/km of loss, measured at 1310nm, plus 0.75dB per mated pair*; 1.0dB/km of loss, measured at 1550nm, plus 0.75dB per mated pair*.
- Single-mode - Outside Plant Cabling: 0.5dB/km, measured at 1310nm, plus 0.3dB per splice and 0.75dB per mated pair; 0.5dB/km, measured at 1550nm, plus 0.3dB per splice and 0.75dB per mated pair.
- Note (*) - Splicing of fiber in the premise cabling system is strongly discouraged and shall be approved by BMS or system designer prior to installation.
- Length Measurements - All fiber runs shall be tested for length measurements to ensure they comply with all installation and manufacturer's warranty requirements. Length measurements shall be recorded along with all required testing parameters and turned over to BMS at the project completion. All test results shall be recorded and identified using the predetermined identified scheme. Cabling contractors shall coordinate all labeling and identification processes with BMS or its agent prior to any labeling efforts.
- Testing Parameters
 - Test jumpers must be of the same fiber core size and connector type as the cable

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system (e.g., 50/125 μm jumpers for a 50/125 μm system).

- The power meter and the light source must be set to the same wavelength.
- The power meter must be calibrated and traceable to the National Institute for Standards and Technologies (NIST).
- The light source or OTDR must operate within the range of 850 $\pm 30\text{nm}$ or 1300 $\pm 20\text{nm}$ for multimode testing, in accordance with ANSI/TIA/EIA-526-14B.
- The light source or OTDR must operate within the range of 1310 $\pm 10\text{nm}$ or 1550 $\pm 20\text{nm}$ for single-mode testing in accordance with ANSI/TIA/EIA-526-7.
- All system connectors, adapters, and jumpers must be properly cleaned before measurements are taken.

4.12.12.2.2 Copper Cabling Requirements - Testing of all copper wiring shall be performed prior to system turnover. Horizontal wiring shall be tested from the information outlet to the termination hardware in each Tele/data Closet. 100% of the horizontal and backbone wiring shall be tested in accordance with ANSI/TIA/EIA-568-B.2 for its respective category rating as well as in full compliance with the following:

- 40 year Limited Lifetime Product and Performance Warranty Program (i.e. Berk-Tek/Leviton or Superior Essex's nCompass program).


4.12.12.2.3 Testing shall be performed with a Level III Field Testing Unit. All installed links shall perform equal to or better than the minimum requirements as specified for that category rating. Any pairs not meeting the requirements of the standard shall be brought into compliance by the contractor or replaced at no additional charge to the owner. All horizontal cabling shall

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be tested under the Permanent Link conditions.


- Category 6 (Voice Grade Trunk Cables) - Testing of each cable shall be performed. Each pair will be tested for continuity with a 99% success rate on a per wiring closet basis. Proper documentation and cut sheet will be prepared, reviewed and signed off upon completion of the installation outlining all pair counts and test status. Failure to meet the 99% success rate will require the Contractor to remove and reinstall the failed trunk cable.
- Category 6A (Horizontal Cabling) - All Category 6A installed links shall perform equal to or better than the minimum requirements as specified in the ANSI/TIA/EIA-568-C.2 (Cable Performance Requirements) and certified to a frequency level of at least 250 MHz. Even if contractor is supplying modular patch cords to BMS, contractor is only required to test the permanent link (NOT Channel).

- 4.12.12.2.4 Warranty Requirements – The following are minimal warranty requirements for all BMS cabling projects. Written approval from BMS or its agent must be obtained prior to making any alterations to any of the following conditions.
- Cabling Contractor Guarantee - Cabling contractor shall be able to extended directly to BMS a 1 year (12 months) installation guaranty, covering installation and termination of all cabling components and supporting hardware, which includes but is not limited to all cables, connectors, cable management products and distribution/supporting hardware. Guaranty shall commence the day of the system cut over and last for a period of 1 year. In the event of an installation defect, cabling contactor shall repair or replace the affected

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component at no additional cost to BMS.

- Contractor must be either Berk-Tek, Superior Essex, or Corning certified installer
- Contractor shall execute a 40yr Limited Lifetime Applications Assurance Warranty for parts and labor to support stated applications from the connectivity (example: Manufacturer Berk-Tek's/leviton or Superior Essex's (nCompass)..
- As further described below, warrant to the customer ("Buyer") that Cable Technologies CAT 6A certified network installations will exceed the defined TIA 568 series industry specifications in force at the time of product purchase. Furthermore, the products that comprise the certified Cable Technologies Cabling System will meet or exceed the applicable performance specifications in effect at the time of manufacture.
- This warranty covers the copper and fiber optic permanent links of the network as defined by TIA-568-C.0 which includes the cable and connecting hardware. This warranty will be extended to include the entire channel provided that the applicable and all products are installed within areas protected from outside elements.
- Supplier will honor claims on this warranty for Life (which is defined as the usable life of the building and is referred to as the "Warranty Period"). If system performance or material fails to meet the appropriate industry specification, the owner must notify Supplier, in writing, within ten 10 days of defect discovery date. If a warranty claim is determined by Supplier in its sole discretion to be valid, Supplier will, at its option, replace or repair the defective components of the permanent link. Supplier may reimburse the claimant for necessary and reasonable labor

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costs, provided prior approval is obtained from Supplier. The liability of Supplier for the above remedies shall not exceed \$300 per each network permanent link or end-user drop.

- The electrical performance provided by the combination of the different components of the permanent link will be certified by Supplier to meet the applicable performance specifications in effect at the time of manufacture as long as each condition listed below is met:
- The network cabling infrastructure must be designed in accordance with TIA 568 Series Standards, and installed by Berk-Tek, Superior Essex, or Corning certified installer Certified or Supplier approved designers and installers. Supplier is not liable for design errors or improper construction.
- Each permanent link or channel in the network must be field tested in accordance with the TIA 568 series industry standard in force at the time of purchase AND the installed permanent links and channels must have passed all applicable TIA and performance requirements. Minimum testing for copper systems includes Wire Map, Length, Attenuation, Near End Crosstalk, Far End Crosstalk, Return Loss, PS NEXT, ELFEXT, and PS ELFEXT.
- Appropriate Warranty Application form must be properly completed and submitted to Supplier prior to initiating the installation. The Warranty Submittal Form must be submitted within 10 days of installation completion. Copies of all certification test reports must be submitted as part of the Warranty Submittal Form, and be kept on file by the registrant to be re-submitted when requested by Supplier. Data must be saved in

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raw data and summary formats. Submitting the data via online upload, e-mail or on disc are the preferred methods for providing test data.

- This Lifetime warranty will be void unless the system is maintained in accordance with industry standards and no changes are made after warranty issuance and acceptance date, unless Supplier grants written consent.
- A claim will be reviewed and held as valid only if all of the following are satisfied:
- Reported within ten (10) days of date of defect discovery.
- ALL installation records are provided (original network installation design prints, test results, warranty submittal form).
- Copies of all original receipts for materials and labor from the date of initial installation.
- Supplier has full and open access to inspect and evaluate the installation site.
- Supplier warrants to Buyer that at the time of delivery the goods sold hereunder will be free from defects in design, material, and manufacture and will conform substantially to the Supplier's applicable specifications as stated herein. Supplier's liability and Buyer's remedy under this warranty are strictly limited to the repair or replacement specified above.
- Corning - Extended Warranty Program (EWP) - Contractors shall be a Corning Cable Systems Certified Contactor in good standing and have the ability to extend to BMS a minimum warranty period of 15-Years. This warranty shall certify that the installation will be free from defects in performance and workmanship, as well as meet or exceed all TIA/EIA performance requirements for Fiber Optic Cabling Systems. Contractor will be


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required to submit all pre-project and post project documentation including test documentation and registration forms as necessary for system warranty coverage under this program.

5.0 DEFINITIONS/ACRONYMS/APPENDICES

5.1 ACRONYMS


- A - Amp, Amperes
- AFF - Above Finished Floor
- AIC - Amperes Interrupting Capacity
- ATS - Automatic Transfer Switch
- AVR - Automatic Voltage Regulator
- BAS - Building Automation System
- BTU - British Thermal Unit
- FR - Code of Federal Regulations
- CIC - Control Interface Cabinet
- CKT - Circuit
- CLG - Ceiling
- CP - Control Panel
- CPS - Continuous Power Systems
- CT - Current Transformer
- D.O.L. - Direct On Line, across the line, line voltage
- Deg - Degree
- DP - Distribution Panel
- Dwg - Drawing
- Elec - Electrical
- EMT - Electrical Metallic Tubing
- Eq - Equal
- FA - Fire Alarm
- Gyp - Gypsum Board
- HH - Hand hole
- HP - Horsepower
- Hz - Hertz
- K - kilo, thousands
- kV - kilovolt
- kVA - kilo Volt-Ampere
- LP- Lighting Panel
- M - Mega, millions
- MACT - Maximum Achievable Control Technology
- Max - Maximum
- MCC - Motor Control Center

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- MDP - Main Distribution Panel
- MDS - Main Distribution Switchboard
- MH - Manhole
- Min - Minimum
- MVA - Mega Volt-Ampere
- NEC - National Electrical Code
- NFPA - National Fire Protection Agency
- NGR - Neutral Grounding Resistor
- NIC - Not In Contract
- NSPS - New Source Performance Standards
- NTS - Not To Scale
- P - Phase(s)
- PP - Power Panel
- Pri - Primary
- PT - Power transformer
- PVC - Polyethylene Vinyl Chloride
- RGS - Rigid Galvanized Steel
- RP -Receptacle Panel
- Sec - Secondary
- Spec - Specifications
- Swgr - Switchgear
- Typ - Typical- Volts
- UPS - Uninterruptible power source
- V - Volts
- VA - Volt-Ampere
- VFD - Variable Frequency Drives
- VPI - Vacuum Pressure Impregnated dry type transformer
- VSD - Variable Speed Drives
- W - Wire(s)
- W/ - With
- W/O - Without
- Xfmr - Transformer

5.2 DEFINITIONS

- Category A (Data Center) - Computing installation that is essential to the business. Loss of these facilities would have wide ranging negative effects to production, manufacturing or economic issues to BMS.
- Category B (Regional Data Room) - Computing installation that is vital, but not essential to the business. These facilities would provide regional support for production, financial or manufacturing operations.
- Category C (Local Data Room) - Computing installations whose loss would pertain

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specifically to the site. These rooms support a single site and contain one or more computers.

- Category D (LAN Closet) - Voice/Data cabling facilities where no servers are present.
- Router - A device that forwards traffic of data between networks based on network-layer information and routing tables, often constructed by routing protocols.
- Server - A computer system that provides one or more network services such as disk storage and file transfer, or a program that provides such services.
- Switch - Equipment that provides the interconnection of LANs, allowing communication between devices on separate virtual segments using similar protocols, and dedicated connections to servers.


6.0 REFERENCES

6.1 FORMS

Form Identification	Form Name
BMS-ENG-FRM-105	<i>Design Standard Waiver Form</i>
BMS-ENG-FRM-120	<i>Data Center Checklist</i>

6.2 INDUSTRY DOCUMENTS

- National Fire Protection Agency (NFPA)
- National Electrical Code (NEC) (NFPA, Chapter 70)
- Underwriters Laboratories Inc (UL)
- Factory Mutual (FM)
- National Electrical Manufacturers Association (NEMA)
- Institute of Electrical and Electronic Engineers (IEEE)
- European Union, Community of Europe (CE)
- Canadian Standards Associations (CSA)
- American National Standards Institute (ANSI)
- ANSI/TIA/EIA-568-B
- ANSI/TIA/EIA-569-A
- ANSI/TIA/EIA-606-A
- ANSI/TIA/EIA-607-A
- ANSI/NFPA-101 (Life Safety Code)
- American Society for Testing and Materials (ASTM)
- UL 1863 (Underwriters Laboratories Standard for Safety – Communications Circuit Accessories)

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7.0 REVISION HISTORY

REVISION	DESCRIPTION	NAME	DATE
0	FIRST ISSUE	Andrew Maude	Sep 2009
1	CHANGES PER ESCR 11	Andrew Maude	Apr 2011
2	CHANGES PER ESCR 0017	Andrew Maude	Jun 2011
3	CHANGES PER ESCR 0030	Andrew Maude	Dec 2011
4	CHANGES PER ESCR 0044	Andrew Maude	Oct 2012
5	CHANGES PER ESCR 0087 & ESCR-0114	Andrew Maude	Aug 2014
6	CHANGES PER ECR-0165	Jorge Linares	Oct 2017



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BMS-ENG-DS-2010

DESIGN STANDARD FOR LIGHTING

Approvals

Author:	Signature	Date
Rich Maurer Associate Director – Project Management Site Engineering – New Brunswick, NJ	Signature on File	Jul 2020
Approved by:	Signature	Date
William Gantz Director – Technical Services Global Engineering	Signature on File	Jul 2020
Frank Gallo Associate Director – Risk Management and Loss Prevention Global EOHSS	Signature on File	Jul 2020

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1.0 PURPOSE

- 1.1. To create prescriptive design standards for use by the Engineering community to respond to projects more quickly and efficiently with minimal investment in the development of design direction.
- 1.2. To drive common engineering design criteria across the company while incorporating flexibility where necessary for GMS and R&D.
- 1.3. To provide flexibility to engineers for prototyping new technologies and alternative approaches based on scale.

2.0 SCOPE

- 2.1. This Design Standard is applicable for new and renovated facilities to promote consistency in designs across BMS facilities.
- 2.2. This Design Standard must be used by architects and engineers involved in new facility construction and major renovations for all facilities occupied by BMS, regardless of the owner of the building.
- 2.3. Design Standard requirements are generally accepted within the industry as proven; however, as with any design, new materials and technology must be evaluated as they become available. Any exceptions from this Design Standard must be documented and submitted as part of a Design Standard Waiver Form (BMS-ENG-FRM-105) and approved by the governing Global EOHSS and Global Engineering Personnel.
- 2.4. Where local laws, codes, or regulations require specific design practices that are in conflict with this Standard, the higher requirements will prevail.

3.0 OVERVIEW

3.1. OBJECTIVE

- 3.1.1. Provide sustainable design guidance that reduces energy consumption.
- 3.1.2. Provide technology that is appropriate and maintainable.
- 3.1.3. Minimize the environmental impact of operating lighting systems.
- 3.1.4. Reduce maintenance burden.
- 3.1.5. Develop lighting systems that are reliable and support operations.
- 3.1.6. Provide lighting systems that support personnel needs.
- 3.1.7. Provide cost effective and energy efficient systems.
- 3.1.8. Assure continued compliance of codes and standards for

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lighting systems.

3.2. QUALITY

- 3.2.1. Lighting fixtures used in an exposed product area must not be located directly above exposed product or materials that will become part of the product.
- 3.2.2. Lighting fixtures used in an exposed product protection area must be designed to prevent potential contamination from dust accumulation that dislodges.
- 3.2.3. Surface luminaires must have impact resistant diffuse lensing, and flush mounting with vertical sides that may be gasketed to ceiling.
- 3.2.4. Surface mounted “teardrop” lensed luminaires must be less than 3 inches wide.
- 3.2.5. Recessed luminaires must have impact resistant diffuse lensing, and gasketed housing.
- 3.2.6. Lighting must be designed such that product manufacturing, testing, and storage is not adversely affected.
- 3.2.7. Manufacturing equipment often utilizes automated safety controls that rely on lasers and/or cameras; room illumination and wireless communication devices shall not interfere with process equipment.
- 3.2.8. For products that are light sensitive, the spectral power distribution and intensity of lighting equipment must be within tolerances permitted by light sensitive products.

3.3. CODES, STANDARDS AND REFERENCES

- 3.3.1. The design professional is responsible for determining all applicable codes and the interpretation and compliance methods.
- 3.3.2. All light fixtures must be listed and have the required national testing and certifications to ensure minimum safety requirements relevant for the location of installation.
 - 3.3.2.1. Within the United States, all light fixtures must use UL listed [UL 1598] Luminaires, using UL compliant components [UL 8750].
 - 3.3.2.2. Luminaires used in Hazardous (Classified) Locations must be UL 844 compliant; listed for applicable Hazard Class (Class 1-gases; Class 2-particulates), Hazard Division (Div. 1-normally present; Div. 2-not normally present or directly adjacent to a Div. 1 space), and Hazard Group (Group letter determined by hazardous substance).

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3.3.2.3. Outside the United States, all light fixture must be UL or CE listed. If UL or CE Certification is not available, fixtures must be Reviewed and Approved by Global Engineering and Global EOHSS.

3.3.3. Lighting components used for emergency illumination must comply with UL 924.

3.3.4. Copper conductors must comply with UL 486A.

3.4. LIGHT COLOR

3.4.1. Color temperature of for all indoor luminaires shall be consistent, utilizing 3500°K, unless site standard is 4000°K.

3.4.1.1. Color temperature deviation. Standard Deviation Color Matching (SDCM) shall not exceed three; provide a maximum 3-step MacAdam ellipse.

3.4.1.2. Exception: Spectrally sensitive labs must utilize luminaires that provide spectral power distribution congruent with science.

3.4.1.3. Exception: Circadian supportive white tunable light shall vary between 2700°K and 5000°K based on time of day.

3.4.1.4. Highest color temperature shall occur between noon and 1 pm. Duration shall be determined by intensity.

3.4.1.5. White tunable LED luminaires shall track along the blackbody locus.


3.4.2. Color temperature of for all outdoor luminaires shall be consistent, utilizing 3000°K, unless local ordinance requires other.

3.4.3. Color Rendering Index and Color Fidelity shall be greater than or equal to 85 for all indoor luminaires.

3.4.4. Color Rendering Index and Color Fidelity shall be greater than or equal to 80 for all outdoor luminaires.

3.4.5. In product inspection areas and laboratories, luminaires must have a Color Gamut within 95 to 105.

3.4.6. Luminaire and control devices must be compatible and coordinated, to prevent flicker. Percent flicker shall be less than 10%.

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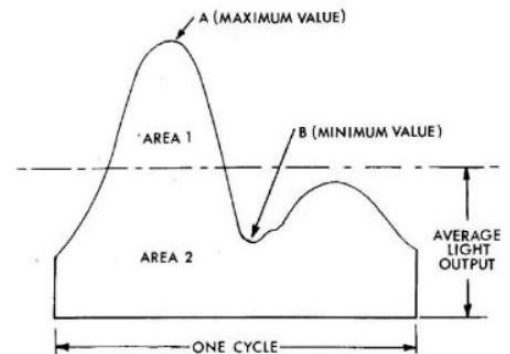
Flicker Metrics

Two metrics proposed by IESNA lighting experts were used to measure the severity of flicker in our test setup: percent flicker and flicker index. Percent flicker is a measure of the depth of modulation of flicker and is calculated using the following formula:

$$\text{Percent Flicker} = 100\% \times (\max - \min) / (\max + \min)$$

Flicker index is a lesser known metric that accounts for the different shapes or duty cycles that the periodic waveforms of AC lighting can have. It is calculated using the following formula with reference to the figure on the right.

$$\begin{aligned} \text{Flicker index} &= \text{Area above Mean} / \text{Total Area} \\ &= \text{Area 1} / (\text{Area 1} + \text{Area 2}) \end{aligned}$$



Source: IESNA Lighting Handbook, 9th Edition (Rea 2000)

3.5. SUSTAINABILITY

- 3.5.1. All installations must be built and operated in the most energy efficient manner, utilizing luminaires with efficacies above 70%.
- 3.5.2. Design shall model principles of ASHRAE Standard for the Design of High-Performance Green Buildings, LEED, and Green Globe.
- 3.5.3. Light sources other than LED must be avoided.
- 3.5.4. Retrofit LED lamps shall not be used.
- 3.5.5. Light fixture efficiencies must comply with Energy Star, DLC, and energy rebate program directives.
- 3.5.6. Lighting control operation must be verified by commissioning agent upon substantial completion.
- 3.5.7. All LED luminaires must be dimmable to at least 10%. High-end trims shall be used to dim to recommended maintained illumination upon start-up.
- 3.5.8. Utilize individually addressable drivers wherever possible.
- 3.5.9. Exterior light pollution must be reduced by using full cutoff luminaires and low reflectance surfaces.
- 3.5.10. Night lighting within buildings, if required for security personnel, shall utilize unswitched life safety emergency lighting and be limited to corridors and entrance lobby.
- 3.5.11. Facilities without 24-hour security rounding the building shall utilize UL924 compliant occupancy sensors to control emergency lighting in corridors.
- 3.5.12. Consider maintenance. Use components with a minimum rated life of

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50,000 hours. Evaluate availability of replacement parts, disposal costs, and ease of access.

- 3.5.13. Confirm attic stock requirements with site facilities director.
- 3.5.14. Consider the use of solar power for site lighting.
- 3.5.15. Campuses shall develop and maintain an exterior lighting master plan that comprehensively factors all exterior luminaires in site illumination calculations.
- 3.5.16. Only light exterior areas as required for safety and security. Assure safety and security while minimizing light pollution and energy consumption.
- 3.5.17. Light exterior building entries to support wayfinding. Visitor entrance shall be better illuminated than employee entries.
- 3.5.18. Exterior tradable areas must comply with the ASHRAE 90.1 allowable lighting power densities. Exterior non-tradable areas (building facades and landscape features) must be at least 50% below the ASHRAE 90.1 allowable lighting power densities.
- 3.5.19. Parking lot lighting shall be individually addressable, dimmable, controlled by photocell, and able to be selectively shut off based on hours of operation.

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4.0 SYSTEM DESIGN BASIS


4.1. LIGHTING AND CONTROLS

4.1.1. Room Design Criteria


4.1.1.1. The following table must be used for determining the lighting design criteria for facilities. Deviations must be reviewed and approved by the BMS representatives on the project.

Table 4.1.1: Room Design Criteria


SPACE TYPE	LIGHTING		CONTROLS									
	ILLUMINATION (Lux) (10Lux=1 Foot-candle)	LUMINAIRE REQUIREMENTS	Occupancy Sensor (on/off)	Vacancy Sensor (off only)	Never-Off Occupancy Sensor	Dimming Switch	Time Schedule Control	Timed Switch	Photocell: Daylight Harvesting	Photocell: Dusk-to-Dawn	Photocell: Monitor	Emergency Controlled (Note 6)
Workplace	450-500 @76cm AFF	Recessed 4" wide lensed linear <i>or</i> Linear direct/indirect pendant	X				X		X			X
Enclave Rm	300-350 @76cm AFF			X		X						
Huddle Rm	450-500 @76cm AFF	Recessed 4" wide lensed linear		X		X			X			
Small Meeting Rm	450-500 @76cm AFF	Recessed 4" wide lensed linear		X		X			X			
Medium Meeting Rm	500-550 @76cm AFF	Recessed 4" wide lensed linear		X		X			X			
Large Meeting Rm	500-550 @76cm AFF	Recessed 4" wide lensed linear		X		X			X			X
Immersive Telepresence Rm	350-400 @76cm AFF	Direct/Indirect		X								X
Open Collaboration	400-450 @76cm AFF		X				X		X			
Print/Copy Rm	300-350 @92cm AFF	Recessed flat panels		X		X						
Office corridors	100-150 @floor						X		X			

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SPACE TYPE	LIGHTING		CONTROLS									
	ILLUMINATION (Lux) (10Lux=1 Foot-candle)	LUMINAIRE REQUIREMENTS	Occupancy Sensor (on/off)	Vacancy Sensor (off only)	Never-Off Occupancy Sensor	Dimming Switch	Time Schedule Control	Timed Switch	Photocell: Daylight Harvesting	Photocell: Dusk-to-Dawn	Photocell: Monitor	Emergency Controlled (Note 6)
Stairways	50-75 @ floor/tread	Wall mounted luminaire			X				X			X
Laboratories	650-750 @92cm AFF	Recessed flat panels	X				X		X			X
Laboratory Corridors	300-400 @92cm AFF	Recessed flat panels	X				X		X			
BSL2+, BSL3 Biology Lab	650-750 @92cm AFF	Recessed Sealed and Gasketed	X				X		X			X
Analytical Lab (Instrument)	650-750 @92cm AFF	Recessed flat panels		X		X			X			X
Specialty-NMR	500-600 @92cm AFF	Non-Ferrous panels	X						X			X
Specialty-Radio Isotope	500-600 @92cm AFF	Surface mounted flat panels	X									X
Quality Lab	800-900 @92cm AFF	Recessed sealed and gasketed	X			X			X			X
High Hazard Lab (H2, H3)	650-750 @92cm AFF	Hazard Class rating consistent with Room's Hazard Class rating						X				X
Freezer Farm Rm	400-450 @92cm AFF	Recessed flat panels	X						X			X
Controlled Environment Lab	700-800 @92cm AFF	Flat panels		X		X						X
Controlled Environment Storage Rooms	400-450 @92cm AFF	Flat panels	X									
General Process Areas, incl. CNC Areas	700-750 @92cm AFF	refer to GMP Quality Considerations					X		X			

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SPACE TYPE	LIGHTING		CONTROLS									
	ILLUMINATION (Lux) (10Lux=1 Foot-candle)	LUMINAIRE REQUIREMENTS	Occupancy Sensor (on/off)	Vacancy Sensor (off only)	Never-Off Occupancy Sensor	Dimming Switch	Time Schedule Control	Timed Switch	Photocell: Daylight Harvesting	Photocell: Dusk-to-Dawn	Photocell: Monitor	Emergency Controlled (Note 6)
Process Corridors	300-400 @floor	refer to GMP Quality Considerations	X						X			
Gowning Areas	300-350 @92cm AFF		X						X			X
Grade 5 Areas	900-1000 @92cm AFF	Teardrop, Grid mount, or Integral to laminar diffusers				X	X		X			X
Grade 7 Areas	900-1000 @92cm AFF	Recessed, triple gasketed (flange, door frame, lens), minimum IP65 rating				X	X		X			X
Grade 8 Areas, CNC w/ Local Monitoring Areas	850-950 @92cm AFF	Recessed, triple gasketed (flange, door frame, lens), minimum IP65 rating				X	X		X			X
Product Inspection Task area only	950-1000 @92cm AFF					X	X		X			X
Vivaria Holding	300(diurnal) /650(task) (Note 1)	Recessed, triple gasketed (flange, door frame, lens), minimum IP65 rating, separately switched red in at least one fixture					X	X			X	X
Necropsy/Procedure	950-1100 @92cmAFF	Recessed, triple gasketed (flange, door frame, lens), minimum IP65 rating		PI R		X			X			X
Vivaria Corridors	300-400 @floor	Recessed, triple gasketed (flange, door frame, lens), minimum IP65 rating	PI R						X			X
General Storage	200-250 @92cm AFF	Recessed flat panels		X		X						

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SPACE TYPE	LIGHTING		CONTROLS									
	ILLUMINATION (Lux) (10Lux=1 Foot-candle)	LUMINAIRE REQUIREMENTS	Occupancy Sensor (on/off)	Vacancy Sensor (off only)	Never-Off Occupancy Sensor	Dimming Switch	Time Schedule Control	Timed Switch	Photocell: Daylight Harvesting	Photocell: Dusk-to-Dawn	Photocell: Monitor	Emergency Controlled (Note 6)
Storage - Small items/Small labels	400-450 @92cm AFF	Recessed flat panels		X		X						
Warehouse Storage	150-200@92cm AFF (Note 2)	High-bay LED with integral occupancy sensor			X				X			X
Utility Rooms	300-350 @76cm AFF	Surface or suspended utility strip with diffuse white protective drop lens						X				X
Machine Shop	500-550 @92cm AFF	Surface or suspended utility strip with diffuse white protective drop lens	X						X			
Toilet Rooms	100-150@floor (Note 2)	Wall mounted luminaires @ vanities	X									X
Locker Rooms	150-200 @floor		X									X
Break Rooms (Mixed use dining/mtg)	250-350 @76cm AFF			X		X			X			X
Cafeteria-Food Prep	500-550 @92cm AFF	Recessed flat panels for back-of-house food prep; LED down lights for servery	X									X
Cafeteria-Dining	150-250 @76cm AFF	LED downlights and accent lighting					X		X			X

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SPACE TYPE	LIGHTING		CONTROLS									
	ILLUMINATION (Lux) (10Lux=1 Foot-candle)	LUMINAIRE REQUIREMENTS	Occupancy Sensor (on/off)	Vacancy Sensor (off only)	Never-Off Occupancy Sensor	Dimming Switch	Time Schedule Control	Timed Switch	Photocell: Daylight Harvesting	Photocell: Dusk-to-Dawn	Photocell: Monitor	Emergency Controlled (Note 6)
EXTERIOR (Note 3)												
Surface Parking Lot	10-15 @grade	Full cut-off optics on 25ft poles					X			X		
Structured Parking	20-25 @grade	Low profile; diffuse, low-glare optics					X		X	X		X
~Entrance of structured parking	500@grade (daytime)									Note 5		
Sidewalks; Active usage	5 @grade	10ft poles or bollards					X			X		X
At secure intercom entries	15-20 @155cm AFF									X		X
Sidewalks; Inactive usage	3 @grade	Full cut-off optics on 15ft poles					X			X		
Roadways (intersections & crosswalks only)	5 @ grade	Full cut-off optics on 25ft poles								X		
Security Gate House	10-15@76cm AFF (Note 4)	Designed to prevent bug ingress		X		X			X			X
Exterior Vehicular approach	15-20 @grade	Full cut-off optics								X		X

Notes:

1. Animal species needs may vary; Refer to AAALAC regulations and DS-2700
2. Provide 200 vertical lux at vanity/shelving face
3. Local ordinances may dictate illumination requirements
4. Provide 300-lux task light for desktop below visual field of security agent viewing exterior approach

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5. Dawn-to-Dusk; increase illumination at entrance when daylight is present
6. Same manner that the normal lighting is controlled. Control shall be bypassed when the unswitched leg of normal lighting power is lost.

4.1.2. Illumination

- 4.1.2.1. Recommended Illumination levels are maintained values measured at the task surface.
- 4.1.2.2. Light Loss Factors used in maintained illumination calculations shall include:
 - 4.1.2.2.1. Lamp Lumen Depreciation of 0.8 for LED technology.
 - 4.1.2.2.2. Luminaire Dirt Depreciation based on luminaire construction:
 - Direct Luminaire w/open bottom: 0.95
 - Direct Luminaire with sealed housing: 0.95
 - Direct Luminaire w/lensed bottom: 0.92
 - Indirect Luminaire: 0.85
 - Exterior Direct Luminaire: 0.72
 - Exterior Indirect Luminaire: 0.65

**Multiply above factors by 0.8 if used in a dirty environment with suspended particles (example: dirty processing/manufacturing)*
 - 4.1.2.2.3. Calculations must utilize appropriate ceiling, wall and floor reflectance for the finish selections specified.
 - 4.1.2.2.4. Utilize point-by-point calculation software such as AGi or ELume Tools.
 - 4.1.2.2.5. Site Scope Boundary: A specific security vulnerability review is required for all new buildings and key infrastructures to determine the extent of lighting coverage outside the boundary of the building/extent of work area and the location of exterior lighting fixtures that will facilitate intrusion detection visibility and nighttime camera coverage.
 - 4.1.2.2.6. For illumination recommendations in areas not identified, follow:
 - IES – Illumination Engineering Society

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- CIBSE- Chartered Institution of Building Services Engineers; SSL- Society of Light and Lighting (for United Kingdom)
- EN 12464 – European Standard – Lighting for Work Places
- EN 1838 – European Standard – Emergency Lighting
- GB 50034 – National Standard of the People’s Republic of China

4.1.3. Luminaire Requirements

- 4.1.3.1. Specific requirements for space types are provided in the table. General requirements for all light fixtures are described below.
- 4.1.3.2. All luminaires shall have dimming drivers.
- 4.1.3.3. Luminaires must be properly heat-sinked to assure LED junction temperature ratings are not exceeded. Manufacturer shall provide operating temperature range for which product is warranted.
- 4.1.3.4. Luminaire flange and mounting must be coordinated with ceiling system.
- 4.1.3.5. Luminaire construction and lensing must prevent direct view of LED modules or direct view of LED module pixilation.
- 4.1.3.6. Retrofit LED lamps must not be used.
- 4.1.3.7. Cord and plug task lights must not be used to comply with illumination requirements. Cord and plug task lighting must not be included in equipment purchased by electrical contractor.
- 4.1.3.8. Hazardous Classified Luminaires: Light fixtures and installation in hazardous areas must be approved for hazardous locations in strict accordance with Articles 500 through 503 of the National Electrical Code.
- 4.1.3.9. Exterior pole mounted luminaires shall include a minimum 6kV surge protection.
- 4.1.3.10. Exterior luminaires in climates that exceed 55°C (140°F) must include temperature sensing safety controls.
- 4.1.3.11. Luminaires must have a minimum 5-year product warranty from date of substantial completion.

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- 4.1.3.12. Warranty shall cover luminaire and driver.
- 4.1.3.13. Warranty shall not require a minimum percentage of inoperable LED modules.
- 4.1.3.14. Manufacturer must be manufacturing light fixtures for a minimum of five years and guarantee replacement components will be available for a minimum of 15 years.
- 4.1.3.15. Luminaire photometric testing shall be performed by an independent test lab using IES testing and measurement protocols.

4.1.4. Occupancy Sensor

- 4.1.4.1. Dual-technology occupancy sensors should be used. (Exception: vivaria and exposed ceiling spaces) If either technology detects occupancy, lights are turned on. If both technologies fail to detect occupancy, lights are turned off after an adjustable time delay set for 10 minutes.
- 4.1.4.2. Use only passive infrared occupancy sensors in vivaria and exposed ceiling spaces.
- 4.1.4.3. Occupancy sensors shall have field adjustable sensitivity settings.
- 4.1.4.4. Do not use occupancy sensors in laboratories and process areas where robotics will operate when the space is not occupied.
- 4.1.4.5. Occupancy sensors in laboratories shall include a second hard wired status contact for BAS interface. (On/Off status of lights are indicative of HVAC system setback.)

4.1.5. Vacancy Sensor

- 4.1.5.1. Vacancy sensors are always used in conjunction with another device (switch or dimmer) that turns lights on.
- 4.1.5.2. Dual-technology vacancy sensors should be used. (Exception: vivaria and exposed ceiling spaces) If both technologies fail to detect occupancy, lights are turned off after an adjustable time delay set for 10 minutes.
- 4.1.5.3. Use only passive all have field adjustable sensitivity settings.
- 4.1.5.4. Do not use vacancy sensors in laboratories and process areas where robotics will operate when the space is not occupied.
- 4.1.5.5. Vacancy sensors in laboratories shall include a second hard-

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wired status contact for BAS interface.

4.1.6. Never-Off Occupancy Sensor

- 4.1.6.1. Use dual-technology sensors in stairwells. If either technology detects occupancy, lights are turned on 100%. If both technologies fail to detect occupancy, lights are dimmed to 10% after an adjustable time delay set for 10 minutes.
- 4.1.6.2. Use infrared sensors in warehouse storage. When sensor detects occupancy, lights are turned on 100%. If sensor fails to detect occupancy, lights are dimmed to 10% after an adjustable time delay set for 10 minutes.
- 4.1.6.3. Use infrared sensors in structured parking. When sensor detects occupancy, lights are turned on 100%. If sensor fails to detect occupancy, lights are dimmed to 25% after an adjustable time delay set for 10 minutes.
- 4.1.6.4. Exterior luminaires deemed to need never-off occupancy sensor operation for security reasons shall use infrared sensors. When sensor detects occupancy, lights are turned on 100%. If sensor fails to detect occupancy, lights are dimmed to required security level after an adjustable time delay set for 10 minutes.

4.1.7. Dimming Switch

- 4.1.7.1. Luminaires controlled by local dimming switches shall have dimming drivers capable of dimming to 1%.
- 4.1.7.2. Dimming switches must be able to turn lights on, off, and control luminaire intensity from 1% to 100%.
- 4.1.7.3. Medium and Large Meeting Rooms shall have A/V interface.
- 4.1.7.4. Immersive Telepresence Rooms shall have A/V interface.
- 4.1.7.5. Immersive Telepresence Rooms shall have low end dimming that remains remain within flicker index acceptable to video equipment. (Video equipment is more sensitive to flicker than the human eye.)
- 4.1.7.6. Dimming switches in Analytical Laboratories must be able to turn lights on, off, and dim down to 1%. (Vacancy sensors will override lights off if dimming switch is left on when room is vacated.) Provide warning sign by switch stating, "Switch controls lights; HVAC remains controlled by occupancy sensor".

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4.1.7.7. Dimming switches in Grade 5, 7, and 8 Areas must be momentary contact on/off operation, capable of overriding time schedule.

4.1.8. Time Schedule

4.1.8.1. Programmable time schedules described below shall be confirmed with the facility manager for the facility's and reflect the actual hours of operation.

4.1.8.2. Time schedule for Workplace lighting shall disable the "off" function of occupancy sensors during normal hours of operation.

4.1.8.3. Time schedule for Open Collaboration lighting shall hold lights off between 10pm and 5am, 7 days/week. (Outside of these hours, occupancy sensors will control.)

4.1.8.4. Office Corridor lighting shall utilize time schedule controls set to turn on one hour prior to start of business and turn off one hour after close of business. [Emergency lighting remains on 24/7 and will serve as night lighting.]

4.1.8.5. Exception: Facilities with 24/7 operation shall utilize occupancy sensor control for normal lighting.

4.1.8.6. Time schedule for Laboratory, Laboratory Corridor, and BSL Biology Lab lighting shall disable the "off" function of occupancy sensors during normal hours of operation.

4.1.8.7. Time schedule for General Process Area lighting shall turn on one hour prior to start of business and turn off at end of cleaning hours.

4.1.8.8. Time schedule for Grade 5, 7, 8 and CNC w/LM Areas shall turn lighting on to 50% at start of business, and turn lighting off one hour after close of business.

4.1.8.9. Discuss diurnal schedule for Vivaria Holding Rooms with lead veterinarian.

4.1.8.10. Time schedule for Dining Areas within Cafeteria shall turn on to 50% at start of business, turn lights to 100% at start of food service, dim lights to 75% one hour after food service closes, and turn lighting off at close of business. Facility manager must be able to access system and override lights on for duration of special events.

4.1.8.11. Time schedule for Surface Parking Lot lighting shall hold lights

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off between 10pm (or within one hour after closing if closing is later than 9pm) and 5am (or within one hour prior to opening if opening is before 6am).

- 4.1.8.12. Exception: Select fixtures needed for safety and security shall not be held off. (No more than 50% of pole-mounted lights in any given parking lot qualify for this exception.)
- 4.1.8.13. Exception: Facilities with 24/7 operation. Parking Lots serving employees working night shifts shall be controlled by dusk-to-dawn photocells only.
- 4.1.8.14. Structured parking facilities shall utilize time schedule controls set to turn on one hour prior to start of business and turn off one hour after close of business.
- 4.1.8.15. Exception: Structured parking for facilities with 24/7 operation shall use never-off occupancy sensors.
- 4.1.8.16. Time schedule for Sidewalks with active usage shall dim to 50% between 10pm (or within one hour after closing if closing is later than 9pm) and 5am (or within one hour prior to opening if opening is before 6am).
- 4.1.8.17. Time schedule for Sidewalks with inactive usage shall be held off outside of normal business hours.
- 4.1.9. Timed Switch
 - 4.1.9.1. Timed switches shall have programmable time out settings with a “flash” warning that blinks lights two minutes prior to automatically turning off lights. Re-pressing the timed switch shall re-start the time out count down.
 - 4.1.9.2. Division 2 High Hazard Labs (H2, H3) shall locate switch outside room, in non-classified area, by door entry and have time out period set for 4 hours. Confirm duration during design development.
 - 4.1.9.2.1. High Hazard Labs that do not have non-classified space outside room entry shall use standard hazardous rated switching.
 - 4.1.9.3. Vivarium Holding Rooms shall use timed switches to increase the diurnal “day” illumination to task illumination levels; during “night” cycles, this switch shall operate a red light within the room.
 - 4.1.9.4. Vivarium Holding Room timed switches shall be programmed

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to time out after 15 minutes. Lights shall not blink nor beep prior to turning off.

4.1.9.5. Large Utility Rooms with multiple entries shall use timed switches programmed to time out after 4 hours. Any switch shall be capable of initiating and re-setting timed out cycle.

4.1.9.6. Small Utility Rooms with one entry shall have time out period set for one hour.

4.1.10. Photocell: Daylight Harvesting

4.1.10.1. Daylight harvesting photocell set points shall be calibrated to maintain the highest recommended illumination level shown in the common space type table.

4.1.10.2. Daylight harvesting should be provided in all areas with perimeter and overhead glazing. Common space types that do not indicate daylight harvesting do so because these spaces are typically interior spaces without natural light penetration.

4.1.10.3. Lighting zones for daylight harvesting shall mimic automatic window shade zoning. (One lighting zone must not include more than one shade control zone.)

4.1.10.4. Photocells shall have an adjustable dead band setting set to prevent cycling of light.

4.1.10.5. Photocells shall have an adjustable time delay preset for 1 minute to prevent system adjustments for rapidly moving cloud cover.

4.1.10.6. Daylight harvesting field start-up services shall include a 6-month follow-up field verification of system settings to accommodate seasonal variations of daylight.


4.1.11. Photocell: Dusk-to-Dawn

4.1.11.1. Dusk-to-dawn photocell may be accomplished via a singular roof mounted site photocell or via photocells integral to site lighting fixtures.

4.1.11.2. Photocells integral to light fixtures shall have dead band setting to prevent cycling of light.

4.1.12. Photocell: Monitor

4.1.12.1. Refer to DS-2700 and AALAC standards for vivarium illumination monitoring and alarming requirements.

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4.1.13. Emergency Controlled

- 4.1.13.1. Use UL924 listed controls to turn emergency lighting off when space is not occupied.
- 4.1.13.2. Do not turn off emergency lighting in areas with 24/7 operation and corridors with 24/7 security surveillance

4.2. **EMERGENCY LIGHTING**

- 4.2.1. Emergency lighting shall be provided for the means of egress, including the exit discharge.
- 4.2.2. Emergency lighting must be provided for all areas in accordance with local laws, codes or regulations.
- 4.2.3. Regardless of occupant density, at least one emergency light must be provided in all laboratories.
 - 4.2.3.1. Exception: Laboratories with light-sensitive work.
- 4.2.4. Emergency lighting must be switched with room lights.
- 4.2.5. Utilize self-testing emergency batteries provided integral to luminaires when central life safety circuits are not available.
- 4.2.6. Lights with integral emergency battery back up must be provided in electrical rooms with ATS or emergency generator equipment.
- 4.2.7. Provide code required illumination at elevator thresholds and elevator control panels.
- 4.2.8. Turn emergency lighting off when space is not occupied.
 - 4.2.8.1. Exceptions: Stairwells, areas with 24/7 operation, and corridors with 24/7 security surveillance.
- 4.2.9. Stairwell lights must be provided with integral emergency battery back up and never-off occupancy sensor operation.
- 4.2.10. Use LED exit signs utilizing 3 watts or less.
- 4.2.11. Exit sign graphics, lettering, and color are governed by applicable local codes.

4.3. **LIGHTING WIRING, CONDUITS AND RACEWAYS**

- 4.3.1. Provide separate full size neutral for each lighting circuit.
- 4.3.2. Equipment, wiring, and circuiting shall accommodate harmonic currents. In countries whose electrical legal requirements follow the NEC or are based on the NEC, comply with NEC 210.4, 220.22, and 310.4.

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- 4.3.3. Conduits and raceways for offices and laboratories must be installed behind the wall.
- 4.3.4. Boxes for switches must be flush mounted.
- 4.3.5. Conduits and raceways for hazardous areas must be behind the wall wherever possible.
- 4.3.6. Conduits for API facility and Aseptic finishing areas must be behind the wall wherever possible. If it is exposed, PVC coated RGS conduit/stainless steel type must be used with sufficient space from the wall to permit cleaning.
- 4.3.7. Refer to DS-2015 Power Building Power Distribution for additional details on raceway systems.

4.4. LUMINAIRE INSTALLATION

- 4.4.1. Luminaires mounted below 10'-0" in mechanical/electrical rooms must be specified with shatterproof lenses or protective wire guards.
- 4.4.2. Recessed luminaires shall be structurally supported independently from suspended ceiling grids.
- 4.4.3. LED drivers must be installed in accessible locations.
- 4.4.4. Luminaires may not be used for through wiring unless specifically rated for through wiring.
- 4.4.5. No convenience receptacle shall be connected to a dedicated lighting circuit.
- 4.4.6. Cords feeding luminaires must directly enter wiring box upon penetrating ceiling.
- 4.4.7. Luminaires and Controls installed in hazardous classified locations must be labeled and approved for such installation.

4.5. CENTRAL LIGHTING CONTROL SYSTEMS

- 4.5.1. Networked central lighting control systems shall be consistent throughout all campus buildings.
- 4.5.2. Utilize wireless control devices within rooms.
- 4.5.3. Utilize individually controllable drivers wherever possible.
- 4.5.4. Provide a written sequence of operation for every control zone.
- 4.5.5. The networked central lighting control system must be able to control lighting on programmable time schedules via astronomical time clock with daylight savings adjustment. Time schedules shall be assignable to day of week and permit holiday overrides.

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- 4.5.6. System shall have integral non-volatile memory loss protection to prevent programming loss during power interruptions.
- 4.5.7. All areas with perimeter or overhead glazing shall utilize daylight harvesting dimming control.
- 4.5.8. Occupancy sensor status shall be shared with BAS.
- 4.5.9. Laboratories must share occupancy sensor status via direct contact closure, not through lighting control system software interface.
- 4.5.10. Control all lighting with high-end trim to dim initial light levels to desired maintained illumination. Specify trim settings on documentation; verify with field measurements.
- 4.5.11. Exception: Luminaires with lumen maintenance dimming control.
- 4.5.12. Networked lighting control systems shall interface via BACNET to BAS system. Systems not designed for constant BAS communication shall utilize a system gateway.
- 4.5.13. Vivarium – refer to DS-2700 and AALAC standards.
- 4.5.14. Commissioning agent shall verify lighting control operation and record all system set points.

5.0 DEFINITIONS/ACRONYMS/APPENDICES

N/A

6.0 REFERENCES

6.1. INDUSTRY STANDARDS

- Illuminating Engineering Society (IES)
- International Energy Conservation Code (IECC)
- National Fire Protection Agency (NFPA)
- National Electrical Code (NEC - NFPA, Chapter 70)
- Underwriters Laboratories Inc (UL)
- Factory Mutual (FM)
- National Electrical Manufacturers Association (NEMA)
- Institute of Electrical and Electronic Engineers (IEEE)
- Design Lights Consortium (DLC)
- Canadian Standards Associations (CSA)
- China Compulsory Certification (CCC)
- European Union, Conformité Européenne (CE)
- Norma Oficial Mexicana (NOM)
- Society of Light and Lighting – United Kingdom (SLL)

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7.0 REVISION CONTROL

Revision	Description	Name	Date
0	First Issue	Ramasamy Velu	12Oct2009
1	Per ESCR-0082, ESCR-0089, ESCR-0112	Andrew Maude	Jul 2014
2	Per ECR-0287	Rich Maurer	Jul 2020

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DESIGN STANDARD FOR FIRE PROTECTION SYSTEMS

Approvals

Author:	Signature	Date
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1.0 PURPOSE

- 1.1. The purpose of engineering Design Standards (DS) program is:
 - 1.1.1. To create prescriptive design standards for use by the Engineering community to respond to projects more quickly and efficiently with minimal investment in the development of design direction.
 - 1.1.2. To drive common engineering design criteria across the company while incorporating flexibility where necessary.

2.0 SCOPE

- 2.1. This Design Standard is applicable for new and renovated facilities to promote consistency in designs across BMS facilities.
- 2.2. This Design Standard must be used by architects and engineers involved in new facility construction and major renovations for all facilities occupied by BMS, regardless of the owner of the building.
- 2.3. Design Standard requirements are generally accepted within the industry as proven; however, as with any design, new materials and technology must be evaluated as they become available. Any exceptions from this Design Standard must be documented and submitted as part of a Design Standard Waiver Form (BMS-ENG-FRM-105) and approved by the governing EHS and Engineering Personnel.
- 2.4. Where local laws, codes, or regulations require specific design practices which are in conflict with this Standard, local laws, codes, or regulations must prevail.

3.0 OVERVIEW

3.1. INTRODUCTION

- 3.1.1. The systems described are generally accepted within the industry as proven; however, as with any system design, new materials and technology must be evaluated as they become available. Nothing in this standard shall be intended to restrict new technologies of alternate arrangements, provided the level of safety prescribed by this standard is not lowered.
- 3.1.2. Whenever BMS builds a new building, or substantially modifies an existing building, automatic fire protection systems (normally automatic sprinkler systems) shall be installed throughout all areas of the new structure.
- 3.1.3. There are many types of facilities. Each may need a different type of Fire Protection system but design philosophies remain the same. The following are key design objectives required during the design:

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- 3.1.3.1. Design Fire Protection systems that are reliable, and meet the facility's needs and the company's risk management objectives.
- 3.1.3.2. Assure continued regulatory and code compliance for the Fire Protection systems.
- 3.1.3.3. Provide technology that is appropriate and maintainable
- 3.1.3.4. Provide cost effective and energy efficient systems.
- 3.1.3.5. Minimize the environmental impact from operation of Fire Protection systems
- 3.1.4. Designs must be compliant with local codes. In many locations, the International Building Code and International Fire Code (or partial adoption of text) predominates. BMS further requires that specific design approaches for Fire Systems follow FM Global Property Loss Prevention Data Sheets. If no FM criterion is available then follow relevant NFPA Standards. All fire protection system components must be FM Approved (listed in FM approval guide and stamped on equipment). If a specific FM Approval is not available, another Nationally Recognized Testing Laboratory certifying body (e.g. Underwriters Laboratories UL) shall be specified.
- 3.1.5. System design must begin with an assessment of the individual building occupancies to determine the fire hazard based on combustible loading. The assessment will further define the appropriate fire protection system suitable for the risk. Once the fire protection system type is defined, the designer will reference the appropriate codes and standards to determine the required sprinkler density, suppressant agent capacity, and duration of delivery. The designer must provide calculations to support the adequacy of the fire protection system design. BMS requires that all decisions for design densities be reviewed with designated BMS Fire Protection subject matter experts and FM Global.
- 3.1.6. Coordinate with the owner/equipment manufacturer on the quantity of hazardous materials in each space, which often require special protection.
- 3.1.7. Review available Process Hazards Analysis data (e.g. HAZOPs) to determine potential system interface requirements with other emergency management systems (e.g. solvent shutdown systems).
- 3.1.8. Address fire alarm and detection design requirements. Determine fire alarm interface requirements with Building Automation Systems to manage emergency ventilation and smoke. Roof smoke/heat vents shall

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be manual.

- 3.1.9. For renovations, use any existing drawings and/or as-built shop drawings and calculations.
- 3.1.10. Use most recent water flow test necessary to support hydraulic calculations for new sprinkler system design. Water flow data no greater than 1 year shall be evaluated and updated.
- 3.1.11. Develop a preliminary protection philosophy, design criteria and scope of work for each project area.
- 3.1.12. Where fire protection systems are used to protect occupancies where there may be potential exposure to environmental receptors from runoff, appropriate containment systems must be provided in accordance with this standard.
- 3.1.13. Address fireproofing design requirements.
- 3.1.14. Address adjacent building exposures, occupant exposures and spacing issues.
- 3.1.15. Coordinate with other engineering disciplines: civil (site fire loop and hydrants), structural (structural fireproofing), electrical (fire alarm, supervision and control), equipment (fireproofing), plumbing (underground fire water supply system and drainage), architectural (number of floors, gross square footage per floor, number and location of exit stairs and any additional stairs, ceiling heights, building elevations, building occupancy classifications, room fire ratings, code analysis), HVAC (duct penetration requirements, smoke removal issues, post-discharge ventilation, interlocks and controls), piping and environmental (drainage, containment).
- 3.1.16. Coordinate with Architect and HVAC regarding any areas that might require protection against freezing. Areas requiring protection against freezing shall first try to eliminate the freeze potential. Second, use dry pipe fire protection. If no alternative solution is available, then glycol system may be used. It shall be noted glycol systems must prescriptively follow NFPA 13 requirements and deviation from NFPA Glycol design criteria shall be approved by the waiver process.
- 3.1.17. Coordinate with water authority and civil engineer for meter location and backflow prevention requirements.
- 3.1.18. Coordinate with Fire Marshall or Plan Reviewer for Fire Department Pumper Connection (FDC) location(s) and other local requirements.
- 3.1.19. FM Global and BMS Fire Protection subject matter experts must be

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contacted early during project development to consult on loss prevention design issues. Additionally, where warranted, an FM Global engineer can be assigned to participate in the project review. FM Global engineers often have information on local water supplies, fire departments, flood zones, the location of utility transmission lines, and hazards presented by nearby facilities. As design progresses, all drawings, designs and working plans must be submitted to FM Global well in advance of the work. During the bid process and during construction, contractors must be kept aware that the project is required to meet FM Global standards.

- 3.1.20. FM shall perform a final review of the design again prior to issuing for construction.
- 3.1.21. After installation of a fire protection system in new construction or in areas that required modification, the facility must perform all required acceptance tests as required by FM Global. Depending on fire protection type, acceptance tests typically include:
 - 3.1.21.1. Visual examination of the installation against original design drawings
 - 3.1.21.2. Review of system materials of construction
 - 3.1.21.3. Hydrostatic testing
 - 3.1.21.4. Water flow testing
 - 3.1.21.5. Pump capacity testing
 - 3.1.21.6. Foam-agent discharge testing
 - 3.1.21.7. Agent discharge or room pressurization test (for gas systems). For high value agents, simulated firing test and room pressurization will be accepted.
 - 3.1.21.8. Functioning of alarms associated with the fire protection system.
- 3.1.22. FM documentation and as-built fire protection system drawings should be transferred to records storage in accordance with DS-1200 Management of Engineering Documents. FM Data Sheets focus on facility loss prevention subject matter and are not intended to address Life Safety Code issues or requirements. Life Safety Code issues and requirements shall be covered in accordance to prevailing local codes (e.g. International Building Code, International Fire Code, NFPA Life Safety Code).
- 3.1.23. Seismic support is required for fire protection systems for facilities

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located in earthquake prone regions. Earthquake bracing designs for risers, cross mains and sprinkler drops must follow FM Global and NFPA 13 Standards.

4.0 SYSTEM DESIGN BASIS

4.1. FIRE WATER SUPPLY AND STORAGE

4.1.1. System Planning

- 4.1.1.1. Fire water for supply to facility fire protection systems can be from three different sources: a natural resource (e.g., lake or river), a municipal supply (e.g., city water) or on-site fire water storage tanks. If the facility has the capability of using municipal water in addition to stored fire protection water, the municipal water supply shall be connected to the fire water main.
- 4.1.1.2. Where on-site water storage tanks are used for multiple purposes, including fire water, the tank must be equipped with systems to assure fire water capacity for 2 hours.
- 4.1.1.3. Water supplies must be immediately available and not require any manual operation, such as making connections, operating valves, or starting pumps to supply water at the time of a fire. The system must be available twenty-four hours a day, seven days per week and have appropriate protection from freezing, floods, drought, hurricanes, earthquakes or other natural occurrences.

4.1.2. System Design

- 4.1.2.1. Adequate water volume and pressure for sprinklers and manual firefighting must be provided from available water supplies to the facility. Adequate water volume and pressure needs for fire protection systems must be determined in accordance with worst case fire demands as defined in appropriate standards (e.g., FM and NFPA, IFC). The available water supply capacity must be available for at least 2 hours for sprinkler systems and hose stream demand combined.
- 4.1.2.2. Storage tanks must be designed with an automated fill and low level alarm tied to a centralized monitoring system.
- 4.1.2.3. Public fire mains can be used to supply on site fire pumps, designed as booster pumps, only after confirming that local water supplies have adequate static pressure and residual

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pressure for the full range of fire pump total output capacity 24/7/365. If more than one booster pump is planned, the arrangement from the public supply must not be subject to common impairment.

- 4.1.2.4. Suction (e.g., a nearby fire hydrant) and a Fire Department Connection (FDC) must be provided to the plant fire main loop to allow fire apparatus to access the water source and pump from the fire apparatus into the site fire water system in the event that a facility fire pump fails or is out of service. Coordinate optimal location with site fire brigades and/or public fire departments.
- 4.1.2.5. The water quality for fire protection systems must not produce unacceptable fouling, corrosion or scaling within the fire water systems. Fire pumps drawing water from natural sources must have inlet screens and sufficient filtering capability to prevent introduction of sediment, debris, stones or other fouling into the fire water piping network.
- 4.1.2.6. Where BMS insurable properties or assets are identified as critical per BMS Business Continuity or when a facility renovation results as critical, the following requirements apply:
 - 4.1.2.6.1. Redundant fire water supplies, each independently capable of meeting the largest individual sprinkler and hose stream demands and not subject to common impairment.
 - 4.1.2.6.2. Each supply must be capable of supplying the largest sprinkler and hose stream demand for 2 hours with each pump location having two pumps per pump house (4 total).
- 4.1.2.7. If a facility renovation is located in a seismically active area per the criteria or designation established by FM Global, additional protections for fire water supply, storage, and distribution may be required.
- 4.1.2.8. Operationally all Fire Water system designs must be provided with a robust inspection, testing, and maintenance program including at least a weekly inspection and annual flow testing schedule meeting NFPA/FM criteria.
- 4.1.2.9. Where public supplies are available to any BMS site (even at

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reduced capacity), a connection should be made to the underground loop for supplementing fire hose usage on yard hydrants by fire departments.

4.1.3. Equipment & Components

4.1.3.1. Storage Tanks

- 4.1.3.1.1. Above ground storage tanks or cisterns are preferred for all applications.
- 4.1.3.1.2. Tanks shall be labeled with tank capacity. Tanks shall be FM approved type, supplied with automatic fill, and provided with local level display and low level alarm.
- 4.1.3.1.3. Tank must be supplied with a vortex breaker depending upon pump size.
- 4.1.3.1.4. For areas where freezing conditions are possible, tank must be provided with a heating system.
- 4.1.3.1.5. Tank must be arranged to facilitate confined space entry for internal examination.

4.2. FIRE PUMPS

4.2.1.1. System Planning

- 4.2.1.1.1. Fire pumps must be installed at a location where they will be protected in the event of an emergency. For example, the fire pump and water supply tank system must not be located within the 500 year or more frequent flood zone or in immediate proximity to a major fire risk. The preference is to install the fire pumps within a separate building not attached to the protected building(s).
- 4.2.1.1.2. All fire pumps and associated hardware must be FM Approved (certified by FM approval marks).
- 4.2.1.1.3. Where only one fire pump is required, it may be electric motor driven if electrical source is reliable from the local utility (verify the frequency of outages). Where more than one fire pump is required, preference is for use of a combination of one electric and one diesel driven pump (where

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electrical source is reliable) or two diesel driven pumps to reduce potential for common electrical impairment.

- 4.2.1.1.4. Where a combination of electrical and diesel driven pumps are provided, preference is for the electrical driven pump to be the primary pump.

4.2.1.2. System Design

- 4.2.1.2.1. BMS prefers split case horizontal fire pumps that self-prime with water sources being suction tanks located above the level of the pump suction. Fire pumps may be arranged as booster pumps from public fire mains.
- 4.2.1.2.2. Fire pumps must be designed to automatically start on water flow demand by use of pressure switches that detect a drop in fire protection system pressure.
- 4.2.1.2.3. Fire pumps must include circulation relief valves to ensure protection against pump overheating.
- 4.2.1.2.4. Fire pumps must be sized to provide sufficient capacity to serve the single largest hydraulic flow anticipated at the facility considering both sprinkler and the greater of two hydrant streams or 500 gpm (1,900 lpm) for hose streams. Consult FM Global to confirm the largest hydraulic flow.
- 4.2.1.2.5. Fire pumps must be provided with a re-circulating flow test loop equipped with an FM approved flow meter to facilitate annual performance tests. A fire pump flow test header shall be provided when required by local code.
- 4.2.1.2.6. Electrically powered fire pumps must be serviced by a dedicated electric line in accordance with NFPA 70 National Electric Code, Article 695.
- 4.2.1.2.7. For diesel fire pumps, the fuel tanks must be sufficient to run the pumps for at least 8 hours. Tank must have level indicator. Fuel tanks shall have a low fuel level alarm
- 4.2.1.2.8. Jockey pumps are required to maintain fire main

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pressure and prevent frequent starting of the main fire pumps.

4.2.1.2.9. All fire pumps must be installed in accordance with FM DS-0307 Stationary Pumps for Fire Protection.

4.3. FIRE WATER DISTRIBUTION AND HYDRANTS

4.3.1. System Planning - Fire Water Distribution

- 4.3.1.1. Fire water mains must not be run under buildings. Whenever any construction requires a new footprint over an existing fire main, the designer must reroute the fire main. Any exceptions must be reviewed with FM Global and a designated BMS Fire Protection subject matter expert (SME) from the EHS team.
- 4.3.1.2. All components of the fire water distribution system shall be FM approved.
- 4.3.1.3. The firewater main shall sub-divide the buildings in a loop configuration with sufficient isolation valves to ensure adequate supplies to all areas during impairment. The sectional valves shall be post indicator valve (PIV) type. Do not use roadway (curb box) valves.
- 4.3.1.4. Except where adjacent public fire hydrants are available to serve all areas of the BMS facility, yard hydrants, and where required, fire hose boxes, must be provided to facilitate manual firefighting by facility fire brigades or local public fire departments.
- 4.3.1.5. All fire main systems shall have a centralized Fire Department Connection (FDC) to provide an alternate means of water supply.

4.3.2. System Planning - Hydrants

- 4.3.2.1. Hydrants must be sufficient in number to ensure required fire water supply for emergency response equipment (see NFPA 24 Standard for the Installation of Private Fire Service Mains and Their Appurtenances).
- 4.3.2.2. Adequate area around hydrants must be available to ensure access for vehicles, placement of hoses and use of valves without obstruction.
- 4.3.2.3. Where hydrants are equipped with special monitor nozzles for manual fire-fighting (e.g., often used in proximity to

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flammable liquid tanks), such systems must have the operating valves located a safe distance from the protected area as to not expose personnel to the hazards of fire or explosion during operation. Adequate clear and flat space around monitor nozzles must be maintained to allow for staging of foam containers commonly used to augment fire water supply. Note however, BMS favors the use of bulk foam supplies as detailed in this standard

4.3.3. System Design – Fire Water Distribution

- 4.3.3.1. BMS preference for fire main piping is cement lined steel pipe. Other FM approved materials of construction are permissible dependent upon local conditions.
- 4.3.3.2. Installation or modifications of fire main piping must be in accordance with FM 3-10 Private Fire Service Mains and NFPA 24 Standard for the Installation of Private Fire Service Mains and Their Appurtenances. In particular, design must strictly address placement and design of anchors and thrust blocks.
- 4.3.3.3. Piping must be sized to meet system demands and BMS requires that mains must not be smaller than 8 inches (20 cm) except in a branch line to a single hydrant (6" minimum; 15 cm minimum) or standpipe.
- 4.3.3.4. Minimize the number of branch lines by connecting only to the main loop to the extent feasible.
- 4.3.3.5. Underground buried fire mains must meet the local frost penetration depth requirements.
- 4.3.3.6. Where pipe trenches are used, installation shall comply with NFPA 24 Standard for the Installation of Private Fire Service Mains.
- 4.3.3.7. Designer shall provide an as-built map detailing the fire protection distribution system and main valves.
- 4.3.3.8. Fire systems maps must identify pipe sizes, valve locations, hydrant locations, fire pumps (with design capacity shown), water supply tanks, buildings, street names and other key equipment.

4.3.4. System Design – Hydrants

- 4.3.4.1. Hydrant spacing must be consistent with local practice [typically no more than 500 feet (150 meters)]. Thread sizes

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on fire hydrants must match the equipment that can be expected to be used with the hydrant and city responders.

4.3.4.2. Water supply to hydrants must be hydraulically designed so that the use of fire hoses from hydrants does not diminish the effectiveness of facility sprinkler systems.

4.3.4.3. Fire hydrants shall be frost-proof (dry barrel type) in climates that have potential to reach freezing temperatures and of a pattern approved by the local authority having jurisdiction.

4.3.4.4. Each hydrant will have a valve (roadway box type) in the supply line to isolate the hydrant during repairs.

4.3.5. Equipment & Components

4.3.5.1. PIVs for existing sites shall match the existing valves. Water control valves must be locked in the full open position.

4.3.5.2. Roadway valve boxes are not approved.

4.4. SPRINKLER SYSTEMS (ALL TYPES)

4.4.1. Introduction

4.4.1.1. Fire sprinkler systems include all automatic and manually activated, water based fire protection systems such as wet sprinkler systems, dry pipe sprinkler systems, pre-action sprinkler systems, deluge systems, foam-water sprinkler systems and other special designs.

4.4.2. System Planning

4.4.2.1. All fire protection systems shall comply with FM datasheet DS-02 *Installation of Sprinkler Systems* and NFPA 13 *Standard for the Installation of Sprinkler Systems*.

4.4.2.2. Sprinklers shall be installed in all areas of all facility buildings unless specifically exempted by another Standard Reference (e.g., not required in high voltage electrical rooms built with 2 hour fire resistance). Partial sprinkler systems shall not be used.

4.4.2.3. Sprinkler systems will be subdivided into zones such that protection is provided to individual areas and individual occupancies to minimize hydraulic design requirements (e.g., large warehouse spaces or manufacturing areas shall be subdivided and office areas shall have a separate riser from the warehouse or manufacturing space).

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- 4.4.2.4. BMS prefers the use of outdoor post indicator valves for building sprinkler systems. The use of interior valves shall be minimized to the extent necessary for branch system or floor control isolation.

4.4.3. System Design

- 4.4.3.1. Sprinkler system materials of construction and connection methods must follow FM DS-0200 Installation of Sprinkler Systems and NFPA 13 Standard for the Installation of Sprinkler Systems.
- 4.4.3.2. Black steel pipe shall be used for all wet pipe sprinkler systems.
- 4.4.3.3. Glycol systems (max 30% propylene) can create a significant increase in fire and explosion hazards and shall only be installed and operated in conformance with NFPA 13 Standards and FM Approved. Glycol systems should not be installed in environments where the temperatures reach below 4.5 °C (40 °F).
- 4.4.3.4. Wet Sprinkler systems shall be designed with engineered and strategically placed automatic air relief devices to minimize air trapped in piping system. Air trapped in the piping system can cause corrosion and increased pipe failures.
- 4.4.3.5. Dry pipe and pre-action must be used to protect areas with sensitive material, equipment or documents. These systems must use a corrosion resistant piping. Both of these require a dry gas system.
 - 4.4.3.5.1. Black steel pipe is allowed only if using an engineered Nitrogen gas system that is FM Approved to purge oxygen.
 - 4.4.3.5.2. If using galvanized pipe or stainless steel pipe, a regenerative air dryer to dehumidify compressed air supply is required so its pressure dew point is 11.1 °C (20 °F) lower than the nominal room temperature. Air intake for the compressed air should be taken directly from room with lowest temperature.
 - 4.4.3.5.3. Compressed air must be connected to the sprinkler pipe through separate duplex lines. Compressed air input must be bled above the deluge valve to

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displace existing air.

- 4.4.3.5.4. Install check valve (with bleed hole) in the compressed air line to block moisture migration coming from priming water after trip test activities.
- 4.4.3.6. All pipe and tube used in sprinkler systems must be designed to withstand a pressure of not less than 200 psi (bars) or 50 psi above WP whichever is greater. Piping shall be a minimum thickness of Schedule 40. Schedule 10 pipe is not acceptable.
- 4.4.3.7. Fire protection systems must be hydraulically designed to deliver adequate water flow and pressure (design density) to effectively control fires within the expected operating area for the most significant fire loading present.
- 4.4.3.8. The design density and operating area must comply with FM Global requirements and applicable codes, and be based on the hazards present, fuel load (commodity classification), burning characteristics, and building construction. The FM datasheets shall be used to identify the specific design densities and design area for each occupancy within the facility buildings. If a FM standard is not available for a specific occupancy, a suitable NFPA standard shall be used for the basis of design.
- 4.4.3.9. Design must allow for at least 18 inches (46 cm) clearance from sprinklers to top of any storage must be maintained in order for water to be effectively delivered for fire control.
- 4.4.3.10. All dry type systems must be designed so that they can be drained completely. Install low-point drains as required to remove all water that can be trapped in these systems following system activation or during testing.
 - 4.4.3.10.1. Arrange dry-type (i.e., dry-pipe, preaction, etc.,) sprinkler system piping to drain back to the system's main 2 in. (50 mm) riser drain. For any part of a sprinkler system that cannot drain back to the system's main 2 in. (50 mm) drain, provide auxiliary drains (or equivalent) that will drain the sprinkler system water to a safe area.
 - 4.4.3.10.2. Arrange the sprinkler system piping to be pitched 1/2 in. per 10 ft (4 mm/m) for all branchlines, and 1/4 in. per 10 ft (2 mm/m) for all other sprinkler

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pipng.

- 4.4.3.11. To reduce corrosion activity caused by trapped air, air vents must be installed on all wet fire sprinkler systems at system high points. These must comply with NFPA 13 requirements. Install minimum 1/2 in (13 mm) FM Approved automatic air-release valves or FM Approved manual valves (remove the air after each time the system is drained and refilled).
- 4.4.3.12. Install an FM Approved pressure-relief valve of not less than ¼ in. (6.4 mm) in size (preferably at the riser or inspector's test connection) to relieve pressure increases caused by thermal expansion. Set the relief valve to operate at pressures greater than the maximum rated working pressure of the system (175 psi [12 bar] typical).
- 4.4.3.13. Sprinkler water flow demand must be designed with a 10 psig cushion below the normal required water pressure to account for fluctuations in water delivery. Maximum velocity in aboveground piping shall not exceed 20 feet per second (6 meters per second).
- 4.4.3.14. All sprinkler systems shall be evaluated for need of a building specific Fire Department Connection (FDC). The review shall be conducted with site EHS and coordinated with the BMS and/or local public response teams as required. FDC shall be labeled to identify the building areas protected by the device.
- 4.4.3.15. Design shall minimize the need for low point drains and branch line sprinkler valves, particularly in concealed spaces.
- 4.4.3.16. All fire protection systems for facilities located within earthquake zones must be provided with earthquake bracing designed per NFPA and FM Global Standards.
- 4.4.3.17. Sprinklers shall be installed below ducts, platforms and equipment over 48- inches (122 cm) wide or as required by FM where overhead water spray is obstructed.
- 4.4.3.18. Sprinklers located in lay-in ceiling areas shall be centered in tiles.
- 4.4.3.19. Designer must consult with BMS on preference for detection systems types that trigger deluge, pre-action, water spray, and foam-water systems.

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4.4.3.20. Where non-potable water supplies are used to supply water to fire protection systems, sprinkler heads shall be installed as “goose necks” of the branch lines.

4.4.4. Equipment & Components

4.4.4.1. Sprinkler heads must be FM Approval listed. BMS requires standard pendent, semi-recessed pendent, or upright sprinkler heads for all applications. Concealed heads are not approved for any new installations with the exception of clean rooms as described in this standard.

4.4.4.2. Sprinklers may not be sealed in any way with aftermarket caulk or gaskets that were not part of the specific manufacturer’s design. Sealed concealed gasket heads, specifically only the most current “Reliable” brand G-Series sprinkler heads with approved sealed gaskets are permissible for GMP clean room applications only. If used, a preventive maintenance program must be implemented to inspect gasket annually to insure no adhesion exists.

4.4.4.3. If using sidewall sprinkler heads, these must be FM approved. BMS will allow use of UL listed sidewall sprinkler heads for light hazard occupancies where sidewall heads offer the best solution for protecting areas with obstructions that would hamper operation of ceiling mounted sprinkler heads.

4.4.4.4. All sprinkler system risers must be fitted with an FM Approved Alarm Check Valve, Dry Pipe Valve or Pre-Action Valve (dependent upon system type) with a 2” drain. An inspector test connection shall be provided at the most remote point on the sprinkler system.

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Table 4.4.1 – Fire Protection System Preferences

Sprinklered Area	BMS Requirement	Additional Details (Note 1, Note 2)	Fire Water Containment Required
Electrical Systems			
Electrical rooms	2 hour fire rated construction and smoke detection (design per NFPA 13 “electrical equipment” section, free of ordinary combustibles or oil-filled equipment with fire detection) and Smoke Detection System.	Total flooding gas agent for rooms lacking 2 hour fire rated construction or with unavoidable combustible loading present	Not required
Large UPS Systems (primary plant power sources)	2 hour fire rated construction and smoke detection (design per NFPA 13 “electrical equipment” section, free of ordinary combustibles or oil-filled equipment with fire detection) and Smoke Detection System.	Total flooding gas agent for rooms lacking 2 hour fire rated construction or with unavoidable combustible loading present	Not required
UPS Battery System Rooms (large battery system for critical server systems, not intended for small UPS sources)	2 hour fire rated construction and smoke detection (design per NFPA 13 “electrical equipment” section, free of ordinary combustibles or oil-filled equipment with fire detection) and Smoke Detection System.	Total flooding gas agent for rooms lacking 2 hour fire rated construction or with unavoidable combustible loading present.	Not Required
Battery Systems	Wet system or pre-action	BMS requires a minimum 0.30 /2500 (gpm/sq.ft. over area sq.ft.) density	Not required

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Sprinklered Area	BMS Requirement	Additional Details (Note 1, Note 2)	Fire Water Containment Required
Cogeneration systems	Wet system (general room). Full flooding Carbon Dioxide inside turbine generator cabinet	Interlock to shutdown generator and fuel supplies upon activation of carbon dioxide system	Not required, (designer must evaluate containment needs for fuel and lube oil systems)
Mechanical and Utility Spaces			
Mechanical, Interstitial space, Chiller room	Wet system and Smoke Detection systems	BMS requires a minimum 0.30 /2500 (gpm/sq.ft. over area sq.ft.) density	Possible (evaluate if there are local environmental concerns for spill containment for chemicals with known environmental impacts (e.g., ethylene glycol, Syltherm))
Forklift battery area	Wet System	BMS requires a minimum 0.20 /2000 (gpm/sq.ft. over area sq.ft.) density	Not required
Mechanical spaces with a corrosive environment	Wet System	BMS requires a minimum 0.30/2500 (gpm/sq.ft. over area sq.ft.) density	Possible (if mechanical space contains storage tanks in excess of 500 gallons per tank)
HVAC Units	Wet System and Smoke Detection System	Sprinklers may be required in larger units that are equipped with substantial filter banks. Protection against freezing required).	Not required
Boiler room	Wet system	High temperature heads near high heat sources	Not Required (designer must evaluate containment needs for fuel oil systems)
Propane (LPG) Gas Tanks >10,000 gallons in a single location	Deluge System/Monitor Nozzles	Required for all vessels greater than 10,000 gallons.	Not Required

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Sprinklered Area	BMS Requirement	Additional Details (Note 1, Note 2)	Fire Water Containment Required
Light and Ordinary Hazard Occupancies (These occupancies should consider standardizing to ordinary hazard where appropriate to allow maximum future flexibility)			
Offices, Locker Rooms, Cafeterias, and similar Light hazard Occupancies	Wet System	BMS requires a minimum 0.20 /2000 (gpm/sq.ft. over area sq.ft.) density	Not Required
Auditoriums	Wet System	BMS requires a minimum 0.20 /2000 (gpm/sq.ft. over area sq.ft.) density	Not Required
Non-hazard process area (ceiling level)	Wet System	BMS requires a minimum 0.30 /2500 (gpm/sq.ft. over area sq.ft.) density	Not Required
Cafeteria Kitchens	Wet System/Dry Chemical System	Cooking ventilation hoods require dry chemical protection systems	Not Required
Parking garages	Dry system	Stand pipes only may be acceptable for locations where garage structure does not expose important plant buildings.	Not Required (Designer must evaluate containment needs for fuels, coolants, and oils as required by local jurisdiction)
Control Rooms, Computer Centers and Records Rooms			
Process Control Room, Automation Equipment Room (I/O rooms)	Wet System	Pre-action system if concern for water damage. No galvanized piping should be used.	Not Required
Computer server room Installation Type "A"	Pre-action system plus room gas agent system	Include gas agent protection for subfloor (12" or higher)	Not Required

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Sprinklered Area	BMS Requirement	Additional Details (Note 1, Note 2)	Fire Water Containment Required
Computer server room '''Installation Type "B" Campus	Pre-action system plus room gas agent system	Include gas agent protection for subfloor (12" or higher)	Not Required
Computer server room '''Installation Type "B" Research & Development or Manufacturing	Pre-action system plus room gas agent system	Include gas agent protection for subfloor (12" or higher)	Not Required
Computer server room " Installation Type "C"	Wet pipe or pre-action system	None	Not Required
GMP Record Storage, Critical Data Storage & Record Storage Room	Wet System or pre- action system	Consider Total flooding gas system for critical records, arranged to discharge ahead of sprinkler system.	Not Required
Laboratories			
High hazard labs (H2 and H3 occupancies)	Wet System	BMS requires a minimum 0.30 /2500 (gpm/sq.ft. over area sq.ft.) density	Required for H2 and H3 rated occupancies
General Chemistry Labs (increased solvent loadings)	Wet system	BMS requires a minimum 0.25 /2500 (gpm/sq.ft. over area sq.ft.) density	Not Required
Biological and Low Hazard Labs (low hazardous material loading)	Wet system	BMS requires a minimum 0.20 /2000 (gpm/sq.ft. over area sq.ft.) density	Not Required
Chemical storage rooms and closets (small control areas)	Wet system		Required if designed as an H3 rated storage occupancy
Bulk chemical storage centers (high hazard classified spaces)	Wet system	Foam water system for high hazard lab storage rooms that store substantial quantities of materials (e.g., H3 classified space serving as the central stores for multiple buildings)	Yes (Note: where foam- water sprinklers are used, containment is also needed in order to enhance effectiveness of foam layer).

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Sprinklered Area	BMS Requirement	Additional Details (Note 1, Note 2)	Fire Water Containment Required
Flammable and Combustible Liquid Applications			
API areas	Wet System	Demand area for design must be largest space that is bounded by fire rated or damage limit construction (fire ratings of less than 2 hours may not be used to subdivide and lessen potential demand area). Interlocks to shutdown transfer pumps and close fire-safe valves for tanks.	Yes (Note: where foam-water sprinklers are used, containment is also needed in order to enhance effectiveness of foam layer).
Pilot Plant	Wet System	Demand area for design must be largest space that is bounded by fire rated or damage limit construction (fire ratings of less than 2 hours may not be used to subdivide and lessen potential demand area). Interlocks to shutdown transfer pumps and close fire-safe valves for tanks.	Yes (Note: where foam-water sprinklers are used, containment is also needed in order to enhance effectiveness of foam layer).
Flammable and Combustible liquids Storage Palletized or Rack Area	Foam-water system/Dry Chemical System	BMS requires that storage racks may not exceed three tiers. Provide dry chemical systems in areas containing water reactive materials.	Yes (Note: where foam-water sprinklers are used, containment is also needed in order to enhance effectiveness of foam layer).
Flammable and Combustible liquids dispensing	Wet system or Foam-water system	Foam-water system may be needed for higher volume dispensing areas supporting API like operations.	Yes (Note: where foam-water sprinklers are used, containment is also needed in order to enhance effectiveness of foam layer)

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Sprinklered Area	BMS Requirement	Additional Details (Note 1, Note 2)	Fire Water Containment Required
Tank Farms and associated truck unloading	Foam water systems/Monitor Nozzles	Options include deluge ring style around each tank or dike perimeter flooding. Interlocks to shutdown transfer pumps and close fire-safe valves for tanks. Provide monitor nozzles.	Yes (Note: where foam-water sprinklers are used, containment is also needed in order to enhance effectiveness of foam layer).
Solvent recovery areas	Deluge water spray systems	Coverage must extend at least 10 ft above any liquid accumulation points (e.g. column bottoms or distillation receivers). Interlocks to shutdown transfer pumps and close fire-safe valves for tanks.	Yes
Pipe racks containing flammable liquid piping	Deluge/water spray systems for 20 ft from important buildings and structures	Supports to be encased with fire proofing. Add direction water spray to steel supports.	No (site infrastructure must account for run-off or spills in areas for pipe racks)
Hazardous Materials Storage Buildings (pre-fabricated types)	Wet System/Dry System	If less than 75 ft from important building, provide sprinkler system. Where dry system is provided as well, arrange for dry system to trigger before sprinkler system to minimize fire water runoff.	Yes (Note: where foam-water sprinklers are used, containment is also needed in order to enhance effectiveness of foam layer).
Solids-OSD Areas and Similar Occupancies			
Transitional Spaces, Interstitial Spaces	Wet System	BMS requires a minimum 0.20 /2000 (gpm/sq.ft. over area sq.ft.) density	Not Required

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Sprinklered Area	BMS Requirement	Additional Details (Note 1, Note 2)	Fire Water Containment Required
Sampling Room (solids only)	Wet system	BMS requires a minimum 0.30 /2500 (gpm/sq.ft. over area sq.ft.) density	Not Required
Raw material staging	Wet system	BMS requires a minimum 0.30 /2500 (gpm/sq.ft. over area sq.ft.) density	Not Required
Powder Process areas	Wet system	BMS requires a minimum 0.30 /2500 (gpm/sq.ft. over area sq.ft.) density	Not Required
Liquid process areas	Wet system	BMS requires a minimum 0.30 /2500 (gpm/sq.ft. over area sq.ft.) density	Not Required unless designated as an H2 or H3 area with hazardous material liquids
Flammable liquids process areas (e.g., ethanol)	Wet System/Pre-action	Foam-water system may be needed for higher volume dispensing areas supporting flammable liquid manufacturing operations.	Yes (Note: where foam-water sprinklers are used, containment is also needed in order to enhance effectiveness of foam layer).
Parenteral and Similar Occupancies			
Process Areas	Wet system	BMS requires a minimum 0.30 /2500 (gpm/sq.ft. over area sq.ft.) density	Not Required
Transitional Spaces, Interstitial Spaces	Wet system	BMS requires a minimum 0.20 /2000 (gpm/sq.ft. over area sq.ft.) density	Not Required
General Process Areas (Non Clean Room)	Wet System	BMS requires a minimum 0.30 /2500 (gpm/sq.ft. over area sq.ft.) density	Not Required

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Sprinklered Area	BMS Requirement	Additional Details (Note 1, Note 2)	Fire Water Containment Required
Biological Products and Microbial Operations			
Transitional Spaces, Interstitial Spaces	Wet System	BMS requires a minimum 0.20 /2000 (gpm/sq.ft. over area sq.ft.) density	Not Required
Upstream biological reactors or fermentation area	Wet system	BMS requires a minimum 0.20 /2000 (gpm/sq.ft. over area sq.ft.) density	Yes
Storage for Biological processes (alcohol soaked resins)	Wet System	Foam –Water system to be evaluated for rooms containing larger quantities of resin or flammable alcohol storage (concentrations >20%).	Yes (Note: where foam-water sprinklers are used, containment is also needed in order to enhance effectiveness of foam layer).
Downstream purification operations	Wet system	BMS requires a minimum 0.20 /2000 (gpm/sq.ft. over area sq.ft.) density	Consider managing fire water flow to reduce potential for area contamination
Alcohol based operations (e.g. column resin or purification column treatment with alcohol solutions)	Wet system	Foam water system for areas where alcohol concentration exceeds 50% (increased fire risk)	Yes (Note: where foam-water sprinklers are used, containment is also needed in order to enhance effectiveness of foam layer).
Environmental Control Chambers			
Walk-In Controlled Storage Rooms 20 °C to 50 °C	Wet system	BMS requires a minimum 0.20 /2500 (gpm/sq.ft. over area sq.ft.) density and shall meet the requirement for the commodity classification.	Not required

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Sprinklered Area	BMS Requirement	Additional Details (Note 1, Note 2)	Fire Water Containment Required
<p>Walk-In Refrigerators</p> <p>5 °C ± 3 °C (2 °C to 8 °C)</p>	<p>Wet system with 30% glycol system or Wet system with dry-pendant heads or Pre-action system</p>	<p>BMS prefers ESFR Sprinkler system for all configurations to avoid the need for in-rack sprinklers. Designer must review latest FM standards for ESFR applicability (building height, rack height, commodity and water supply). ESFR system preferred (where allowed by FM standards), filled with MAXIMUM of 30% factory blended propylene glycol). CAUTION: Glycol system can create a significant increase in fire and explosion hazards and shall only be installed and operated in strict conformance with NFPA 13 Standards.</p>	<p>Possible (where local jurisdiction requires and/or evaluate if there are local environmental concerns for spill containment of propylene glycol))</p>
<p>Walk-In Freezers</p> <p>-20 °C ± 5 °C (-15 °C to -25 °C)</p> <p>-40 °C ± 10 °C (-30 °C to -50 °C)</p>	<p>2 hour fire rated construction to encapsulate freezers with fast detection Smoke Detection System (Pro X -freezers or Vesda -coolers).</p>	<p>Subdivide freezer space so that no more than \$100 MM in commercial value of the product is in any single freezer.</p>	<p>Not Required</p>

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Sprinklered Area	BMS Requirement	Additional Details (Note 1, Note 2)	Fire Water Containment Required
Warehousing (Raw materials, packaging and finished goods)			
Rack Storage Area - Warehouse:	Wet system	BMS prefers ESFR Sprinkler system for all configurations to avoid the need for in-rack sprinklers. Designer must review latest FM standards for ESFR applicability (building height, rack height, commodity and water supply).	Possible (where local jurisdiction requires)

Note 1: BMS requires that all decisions for design densities be reviewed with designated BMS Fire Protection subject matter experts and FM Global.

Note 2: Wherever Foam Systems are to be installed, EHS must be consulted on current regulations that may restrict the use of Fluorine containing foams.

4.5. FIRE PROTECTION SYSTEM ALARMS

4.5.1. Introduction

- 4.5.1.1. This Standard is intended to address Fire Alarm systems directly related to Sprinkler Systems and Suppression Systems and their operations. For Life Safety Fire Alarms Systems, such as smoke detection, heat detection and pull box stations, reference BMS Design Standard BMS-ENG-DS-2005 *Electrical Auxiliary Systems*.

4.5.2. System Planning

- 4.5.2.1. Fire protection systems and any special suppression/protection systems must be equipped with alarms which will notify a 24/7/365 manned central monitoring location.
- 4.5.2.2. Fire alarm design must consider requisite interfaces to other plant systems.
- 4.5.2.3. Prepare an Emergency Shutdown Statement of Requirements document to identify key systems which need to be interlocked with the actuation of the fire protection system. The designer shall reference available documentation,

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including Process Hazard Analysis studies (e.g. HAZOP).

4.5.3. System Design

- 4.5.3.1. Each main sprinkler system zone (riser) must be equipped with a flow alarm.
- 4.5.3.2. Each fire pump must be provided with a pump running alarm.
- 4.5.3.3. Each dry pipe sprinkler system must be provided with a supervisory air loss alarm.
- 4.5.3.4. Each pre-action system must have an alarm for the detection system that triggers flow of water into the pipe network.
- 4.5.3.5. Each special protection system (foam, dry chemical, gas) must have a discharge alarm. Gas systems must have a pre-activation alarm system to warn occupants of impending agent discharge.
- 4.5.3.6. All fire alarms shall lock in alarm once activated. Alarms shall require human intervention to clear alarms.
- 4.5.3.7. At least two independent and reliable power supplies must be provided for fire alarm systems, one primary and one secondary (battery), each of which must be of adequate capacity for the application. Provide in accordance with NFPA 72, National Fire Alarm Code.
- 4.5.3.8. Early warning air sampling devices such as “VESDA” systems are only to be used in high value/risk Class “A” data centers or high value/risk product storage facilities. Because of the specialized design and technology of these devices each system shall be reviewed and approved by BMS Fire Protection subject matter expert. In most cases, VESDA systems should only be used for a secondary, fast acting detection system and are not recommended for triggering fire protection systems.
- 4.5.3.9. Activation of a fire suppression system shall activate the general building fire alarm system.
- 4.5.3.10. Smoke detectors are required in any area that is not normally occupied such as mechanical rooms, electrical rooms and interstitial spaces. Refer to BMS Design Standard BMS-ENG-DS-2005 Electrical Auxiliary Systems.

4.6. STANDPIPE AND HOSE SYSTEMS

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4.6.1. System Planning

- 4.6.1.1. Project must include provisions for standpipes in accordance with applicable codes, giving consideration to planning factors such as: presence of central site fire department connection (or not), local fire department (or AHJ) requirements, building height, building width, distance from hydrants, and accessibility for firefighting. Risers may be wet or dry dependent upon local requirements and climate.
- 4.6.1.2. Project shall not provide fire hose systems unless specifically required by the local authority having jurisdiction.
- 4.6.1.3. Standpipe systems must be provided in every exit stairway, on each side of the wall adjacent to the exit openings of horizontal exits and in each exit passageway. Where stair towers are enclosed, the standpipe and hose connections shall be located inside the enclosed stair tower.
- 4.6.1.4. Adequate space shall be provided to allow unobstructed operation of the valve and connection of a fire department hose.
- 4.6.1.5. Coordinate with site personnel and fire department for thread size and type of fire department connections.

4.6.2. System Design

- 4.6.2.1. Design must conform to NFPA 13 Standard for the Installation of Sprinkler Systems, NFPA 14 Standard for the Installation of Standpipes and Hose Systems and FM 4-4N.
- 4.6.2.2. Standpipes shall be wet unless the area is 40°F (4.4°C) or less or where water filled pipe is undesirable.
- 4.6.2.3. Standpipes must be equipped with a drain system.
- 4.6.2.4. Provide isolation valve for each standpipe, separate from sprinkler riser, to avoid common impairment.
- 4.6.2.5. Make provisions for backflow prevention if there is potential to contaminate public water supplies.

4.6.3. Equipment & Components

- 4.6.3.1. Provide a FM Approved post indicating valve in an accessible location to control the source of water supply.
- 4.6.3.2. Install a 3 in (76 mm) test/drain riser to enable tests of any installed pressure regulating devices on standpipes.

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4.6.3.3. Where two or more standpipes are provided within the same building or section of building, they shall be interconnected.

4.6.3.4. Provide signs indicating the location of stairways equipped with standpipes.

4.7. GAS SUPPRESSION SYSTEMS

4.7.1. System Planning

4.7.1.1. The design and installation of any special suppression/protection systems must be in accordance with appropriate FM and NFPA standards governing the design and installation of carbon dioxide and clean agent gas suppression system on an occupancy and equipment specific basis.

4.7.1.2. Carbon dioxide or gaseous systems in any location that might expose personnel to asphyxiation risk are not permitted. Specialized systems that are not asphyxiates are available

4.7.1.3. Rooms or equipment with flooding gas suppression system need to be design with enclosures that maintains gas agent concentration when discharged.

4.7.1.4. All agents shall be approved and listed by FM Global (FM-200 and Novec 1230 are preferred). Agents with low Global Warming Potential (GWP) are preferred.

4.7.2. System Design

4.7.2.1. As required within this standard, provide a FM approved total flooding gaseous extinguishing system (e.g., FM 200 or Novec 1230) to protect Computer Server Rooms and Control Rooms/Security Centers. The system shall be activated by a cross-zoned smoke detection system using conventional type smoke and heat detectors. This detection system will be independent from the detection system used for the pre-action sprinkler system.

4.7.2.2. Early warning or activation air sampling devices such as “VESDA” systems are only to be used in high value/risk installation Class “A” data centers or high value/risk product storage facilities. Because the specialized design and technology of these devices each system shall be review and approved by BMS internal fire protection specialist. In most cases VESDA systems should only be used as a secondary, fast acting detection system and are not recommended to trigger

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gas agent and pre-action fire protection systems.

- 4.7.2.3. Rooms, doors, dampers, and other openings must be equipped with automatic closure devices upon agent discharge.

4.7.3. Equipment & Components

- 4.7.3.1. Air distribution system shall be shutdown and isolated by dampers.
- 4.7.3.2. Removable flooring systems and ceiling tiles must remain secure.

4.8. FOAM-WATER SPRINKLER SYSTEMS

4.8.1. Introduction

- 4.8.1.1. Historically, some fire-fighting foam concentrates have contained a class of compounds known as per- and polyfluoroalkyl substances (PFAS). Some jurisdictions are promulgating soil, groundwater and/or drinking water standards for PFAS compounds, both individually and aggregate, as some of these compounds are persistent in the environment, resistant to environmental degradation processes and bioaccumulate. Before proceeding with any new foam sprinkler system design, an evaluation must be performed to determine the most environmentally suitable foam that addresses the fuel hazard and local environmental regulations. Foam-water sprinklered areas should incorporate appropriate containment to prevent potential release of PFAS compounds to the environment.

4.8.2. System Planning

- 4.8.2.1. BMS requires the use of foam-water sprinkler systems for tank farms and drum storage occupancies containing flammable liquids.
- 4.8.2.2. Delivery and mixing stations for foam delivery systems must be located in a safe area appropriately spaced from the protected hazard. BMS requires the main foam infrastructure delivery system be located in a separate room or detached building, away from the protected hazard zone.
- 4.8.2.3. The foam system design must provide blanketing for the protected hazard requiring the use of dikes or curbs to help maintain the foam layer. Appropriate containment and/or

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drainage systems must be provided to capture at least 30 minutes of fire water flow at the full design capacity (sprinklers and total hose stream).

- 4.8.2.4. Where systems are equipped with foam pumps, the pump driver (typically electric) must be provided with a dedicated and reliable power supply.
- 4.8.2.5. BMS prefers aqueous film forming foam (AFFF) in lieu of high expansion foams. Utilize a foam agent that has widespread use and compatibility (e.g., Universal Gold).
- 4.8.2.6. Areas protected by AFFF must utilize a design that allows for continued flow of water when foam agent is depleted.
- 4.8.2.7. BMS prefers fixed foam storage tank systems in lieu of individual drum (on-the-spot) delivery systems.

4.8.3. System Design

- 4.8.3.1. Designer must consult BMS to select the appropriate foam-water system design (e.g. foam water sprinkler, pre-action foam water sprinkler, or deluge foam water sprinkler).
- 4.8.3.2. Designer must consult BMS on the specific detection and actuation systems. BMS prefers automatic in lieu of manually activated systems for all applications.
- 4.8.3.3. Foam shall be selected for the specific flammable or combustible material being protected.
- 4.8.3.4. BMS requires foam to be delivered at the required concentration for a minimum of twenty (20) minutes.

4.8.4. Equipment and Components

- 4.8.4.1. Sprinklers, deluge nozzles, and water spray nozzles must be specifically chosen and approved for delivery of foam.
- 4.8.4.2. Galvanized piping shall only be considered for open head deluge systems
- 4.8.4.3. All foam system components must be FM Approved.

4.9. DRY CHEMICAL SYSTEMS

4.9.1. System Planning

- 4.9.1.1. BMS requires the use of dry chemical systems for laboratory fume hoods, and hazardous materials storage buildings and rooms where materials are known to have reactivity with

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water-based fire protection. Specifically the following applications require dry chemical protection:

- 4.9.1.2. In all laboratories walk-in fume hoods or any hood greater than eight (8) feet (2.5 meters) in length. If a dry chemical system cannot be used due to the nature of the materials in the hood, then the design shall be a wet suppression system utilizing a water mist system or equivalent.
- 4.9.1.3. In storage sheds or storage rooms where water reactive chemical are stored in bulk quantities (including pre-fabricated chemical storage buildings).

4.9.2. System Design

- 4.9.2.1. Design and installation must be in accordance with FM datasheet 4-010, Dry Chemical Extinguishing Systems and NFPA 17, Standard for Dry Chemical Extinguishing Systems.
- 4.9.2.2. Pre-engineered dry chemical system must be designed in accordance with UL 1254 Pre-Engineered Dry Chemical Extinguishing System Units.

4.10. WET CHEMICAL EXTINGUISHING SYSTEMS

4.10.1. System Planning

- 4.10.1.1. BMS requires the use of wet chemical agent systems (mixture of inorganic salts and liquid suppressant such as Ansul R-102) for all cafeteria/kitchen hoods used for exhausting oils or grease from stoves and cookers.

4.10.2. System Design

- 4.10.2.1. Design and installation must be in accordance with NFPA 17A, Standard for Wet Chemical Extinguishing systems and UL 300, Fire Testing of Fire Extinguishing Systems for Protection of Restaurant Cooking Areas.

4.11. FIRE WATER CONTAINMENT

4.11.1. System Planning

- 4.11.1.1. Where required by local code, standard, DS-2070 Storage and Handling of Hazardous Material or any BMS Engineering Design Standard, system drainage and containment systems must be provided for retention of potentially-contaminated fire water. The International Building Code, adopted by BMS for new construction, requires fire water containment for H-

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rated occupancies. Additionally, BMS has identified specific occupancies requiring containment including:

4.11.1.1.1. API Pilot Plant & Manufacturing

4.11.1.1.2. Bulk Unloading Stations

4.11.1.1.3. Bulk Chemical Tank Farms

4.11.1.1.4. Drum Storage Buildings and Centralized Drum Storage Rooms

4.11.1.1.5. Biologic Cell Culture & Fermentation areas (upstream processing areas)

4.11.1.1.6. Certain Highly Potent Compound areas (consult with EHS).

4.11.1.2. Where sensitive environmental receptors are present (e.g. operations immediately adjacent to wetlands)

4.11.1.3. Many jurisdictions, particularly Europe, require substantial containment capacities for the full duration of expected operation (e.g., equal to fire water storage tank capacity). Consult with local EHS staff to confirm local jurisdiction requirements. Minimum, containment for 30 minutes.

4.11.1.4. Maximize the use of gravity flow in the design of drainage and containment systems in lieu of pumps to maximize reliability.

4.11.2. System Design

4.11.2.1. The collection and containment system must be impervious with suitable construction or lining to prevent migration of spills to the environment and the outlet drain must be closed.

4.11.2.2. The containment system must terminate in a tank, pond or basin having a capacity not less than 110% of the greatest amount of liquid that can be released from the largest tank served by the containment system (dike/bund) and at least 30 minutes of fire water flow at full design capacity (sprinklers and total hose stream). The design must also account for additional volume for a significant rain event where storm water can be collected or accumulate along with fire water.

4.11.2.3. Where a building drainage system or outdoor spill collection system is piped away to a secondary containment system (i.e., for collection of spills and fire water impounding), its route must be located to avoid exposure to tanks or adjoining

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property in the event that the flammable or combustible liquids in the containment system are ignited.

- 4.11.2.4. For guidance on design and installation of drainage, refer to FM 7-83 Drainage Systems for Flammable Liquids.

4.11.3. Equipment & Component

- 4.11.3.1. Drainage systems must have trap design to minimize fire risk within the system.

4.12. PORTABLE FIRE EXTINGUISHERS

4.12.1. System Planning

- 4.12.1.1. Extinguishers must be provided in all BMS facilities, whether owned or leased.
- 4.12.1.2. Spacing of extinguishers must be compliant with Applicable Codes. Extinguishers must be strategically and conspicuously located in areas where fires are likely to occur and along paths of exit travel.
- 4.12.1.3. All dead end corridors greater than 25 feet in unsuppressed buildings shall have extinguishers installed.

4.12.2. System Design

- 4.12.2.1. The type, size and spacing of extinguishers and quantity required shall be matched to the specific hazards of the occupancy and shall also comply with NFPA 10 Standard for Portable Fire Extinguishers.
- 4.12.2.2. Dry chemical extinguishers are preferred for outdoor locations.
- 4.12.2.3. All agents must be approved and listed by FM Global and Underwriters Laboratories or equivalent.

4.13. SPECIAL OCCUPANCIES PROTECTION

4.13.1. Introduction

- 4.13.1.1. For hazardous material storage design requirements refer to BMS-ENG-DS-2070 Storage and Handling of Hazardous Materials

4.13.2. Loading/Unloading facilities for trucks or Bulk Containers

- 4.13.2.1. Facilities for unloading flammable liquids shall be protected by automatic foam-water deluge systems described in this

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standard.

- 4.13.2.2. The exposure protection for the loading/unloading pads and transfer pumps shall be accomplished as follows:
 - 4.13.2.2.1. Open upright sprinklers shall provide protection for the structure, top of the vehicle and the surrounding area including transfer pumps.
 - 4.13.2.2.2. Open sprinklers located on the lower structure shall deliver foam to the underside of the vehicle and over the ground below.
- 4.13.2.3. Pipe racks within 20 ft (6 m) distance from the loading/unloading station, roof supports, and structural load-bearing steel supports for the equipment platform shall be fireproofed.
- 4.13.2.4. Loading/Unloading areas shall be provided with fire water containment for a duration of 30 minutes, plus the capacity of the tank truck. If storm water is a factor, an allowance for a rainstorm event shall also be included.

4.13.3. Fuel Storage

- 4.13.3.1. All liquid fuel (diesel and gasoline) storage tanks shall have secondary containment. The secondary containment volume shall be at least as large as the primary tank. Fuel tanks shall not require fixed fire protection systems unless there is an exposure to important plant buildings and structures.
- 4.13.3.2. All LPG fuel storage over 10,000 gallons (37,800 liters) capacity in a single location shall have deluge fire protection.
- 4.13.3.3. In instances where the need for a fire protection system for fuel systems is questionable, a risk assessment shall be performed in conjunction with EHS to determine if fuel type and capacity warrant fire protection.

4.13.4. Solvent Recovery

- 4.13.4.1. Solvent recovery systems require deluge sprinkler protection to at least 10 feet (3 meters) above all liquid hold-up within columns and surrounding all tanks and infrastructure located near grade level. Directional water spray protection is needed on all supporting steel members for the structure.
- 4.13.4.2. Where pipe racks to and from solvent recovery systems are

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multi-tiered and may contribute to fire spread between important buildings and structures (dependent upon proximity), deluge protection shall be required for the pipe rack system. Consult with local EHS and FM Global.

- 4.13.4.3. Fire water containment controlled by area containment diking and/or curbs is needed around the distillation column group and associated recovery tanks. Design should account for fire water and hose streams for 30 minutes, plus the largest anticipated spill. If storm water is a factor, an allowance for a rain storm event is required.

4.13.5. Pipe Racks

- 4.13.5.1. Pipe racks do not generally require automatic fire water protection systems, but shall have fire rated supports on legs located within 20 ft. (6m) of significant fuel loads such as unloading stations and tank farms.
- 4.13.5.2. Where pipe racks connect main buildings or other important structures spaced closer than 50 ft. (15 m), and racks transport flammable liquids, the pipe rack must be protected with deluge systems.

4.13.6. Cooling Towers

- 4.13.6.1. Cooling towers shall be built of noncombustible materials. Ideally, FM approved cooling tower components shall be specified such that towers do not require fire protection. For example, the cooling tower's structure, fan and distribution decks, louvers, and fill materials shall all be of noncombustible materials (concrete, masonry, tile, metal, etc.).
- 4.13.6.2. If the above cannot be provided with strict adherence to FM specification, then fire protection systems will be required inside the cooling towers.

5.0 DEFINITIONS/ACRONYMS/APPENDICES

5.1. DEFINITIONS

- Building Code: A law that sets forth minimum requirements for design and construction of buildings and structures
- Class "A" Data Center Installations (BMS Data Center): An enterprise data center that is essential to the business. Loss of this facility would have significant and wide-ranging negative effects to BMS. Applications and systems housed in this type of facility are used globally or regionally. These

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sites need the highest availability and redundancy. “A” installations are considered essential to the business. Loss of these facilities would have wide ranging negative effects to production, manufacturing or economic issues to the corporation. They are designed to be operated and maintained with essential services uninterrupted to the end use systems. Generally all systems are redundant to N plus one standards. Outages of any kind are unacceptable to designated equipment. System failures of major components are transparent to the end users and backup systems are fully automated.

- Class “B” Data Center Installations (Research & Development or Manufacturing): A server room that supports local research and development systems or manufacturing. Loss of this facility would have a significant impact on the discovery, pipeline, production or delivery of BMS product to patients. These sites should have high availability and redundancy. They are designed to be operated and maintained with minimal impact to essential services. Scheduled downtime is acceptable. System failures may need human intervention.
- Class “B” Data Center Installations (Campus): A server room that is essential to multiple sites or buildings. Loss of this facility would have significant and wide-ranging negative effects to BMS. Applications and systems housed in this type of facility are used regionally or locally. These sites should have high availability and redundancy. They are designed to be operated and maintained with minimal impact to essential services. Scheduled downtime is acceptable. System failures may need human intervention.
- Class “C” Data Center Installations (General Office): A local server room that supports a single location or building. The room may host local file, print, and backup servers, but does not host critical (GxP or financial) business application servers. Loss of this facility would be disruptive to the business, but would not significantly impact the development or manufacturing of BMS products. These sites should have normal availability and redundancy is recommended, but not required.
- Deluge System: A sprinkler system employing open sprinklers that are attached to a piping system that is connected to a water supply through a valve that is opened by the operation of a detection system installed in the same areas as the sprinklers. When this valve opens, water flows into the piping system and discharges from all sprinklers attached to the branch lines in that system.
- Dry Pipe System: A sprinkler system having automatic sprinklers that are attached to a piping system containing air under pressure, the release of

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which (as from the opening of a sprinkler) permits the water pressure to open a valve known as a dry pipe valve, and the water then flows into the piping system and out the opened sprinklers.

- **Fire Alarm System:** A system designed to effectively warn of a fire through audio or visual means, such as a public announcement, bell, horn, siren and flashing strobe light or beacon, and to alert external response agencies of the existence of a fire emergency.
- **Fire Detection System:** A system of controls, initiating devices and alarm signals in which all or some of the initiating circuits are activated by automatic devices, such as smoke detectors, designed to detect the presence of a fire signature and to initiate action.
- **Fire Door:** The door component of a fire door assembly that includes; frame, hardware and other accessories that together provides a specific degree of fire resistance to an opening in a fire wall.
- **Fire Extinguisher:** Portable or movable apparatus used to put out a small fire by directing onto it a substance that cools the burning material, deprives the flame of oxygen, or that otherwise interferes with the chemical reactions occurring in the flame.
- **Fire Hydrant:** A device designed with a valve and spout for drawing water from a water main for firefighting purposes.
- **Fire Partition:** A time-rated wall subdividing a floor or area within a building, usually extending from the floor to the underside of the floor above.
- **Fire Protection System:** An installed system made up of equipment designed to prevent, control and limit damage from fire, warn occupants of the existence of a fire emergency, enhance their escape and survival, and summon assistance when required.
- **Firewall:** A time-rated wall providing separation for fire protection between building areas. Firewalls extend from the basement through the roof.
- **Flammable Liquid:** Any liquid that has a closed-cup flash point below 100°F (38°C).
- **Class I Liquid:** Any liquid that has a closed-cup flash point below 100°F (38°C) and a vapor pressure not exceeding 40 psia (2070 mm Hg) at 100°F (38°C).
- **Class IA liquids:** Those liquids that have flash points below 73°F (23°C) and boiling points below 100°F (38°C)
- **Class IB liquids:** Those liquids that have flash points below 73°F (23°C) and boiling points at or above 100°F (38°C)

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- Class IC liquids: Those liquids that have flash points at or above 73°F (23°C), but below 100°F (38°C).
- Foam: An aqueous suspension of a foam solution in air/gas.
- Chemical foam: Obsolete and discontinued.
- Mechanical foam: Replaced chemical foam using spray nozzles or heads to create foam bubbles from mechanical action.
- Protein Foam: From natural protein sources like animal feathers, hoof and horn. Excellent against radiant heat and re-ignition.
- Fluoroprotein foam: A protein foam with fluorochemical surfactant to produce easy flowing protein.
- Aqueous Film Forming Foam (AFFF): A synthetic foam concentrate combines fluorochemicals and hydrocarbon surfactants with no protein.
- Alcohol-Resistant Aqueous Film Forming Foam (AR-AFFF): Use to suppress fire of water-soluble fuels.
- High-expansion foam: Use in confined space, paper fire and jet fuel fire.
- Flash Point: The minimum temperature of a liquid at which sufficient vapor is given off to form an ignitable mixture with the air, near the surface of the liquid or within the vessel used, as determined by the appropriate test procedure and apparatus.
- Life Safety Program: Minimum requirements to ensure that a building or structure is constructed, arranged, equipped, maintained, and operated to avoid undue danger to the lives and safety of its occupants from fire, smoke, fumes or resulting panic during the period of time reasonably necessary for escape from the building or structure in case of fire or other emergency.
- Occupancy: The purposes for which a building or structure is used or intended to be used.
- Sprinkler System: For fire protection purposes, an integrated system of underground and overhead piping designed in accordance with fire protection engineering standards. The installation includes one or more automatic water supplies. The portion of the sprinkler system aboveground is a network of specially sized or hydraulically designed piping installed in a building, structure, or area, generally overhead, and to which sprinklers are attached in a systematic pattern. The valve controlling each system riser is located in the system riser or its supply piping. Each sprinkler system riser includes a device for actuating an alarm when the system is in operation. The system is usually activated by heat from a fire and discharges water

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over the fire area.

- **Suppression System:** A system that utilizes a special firefighting agent that is automatically applied to a fire and designed to fully extinguish the fire.
- **Wet Pipe System:** A sprinkler system employing automatic sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by heat from a fire.

5.2. ACRONYMS

- ADA – Americans with Disabilities Act
- AFFF – Aqueous Film Forming Foam
- AHJ – Authorities Having Jurisdiction
- ANSI –American National Standards Institute
- AR-AFFF – Alcohol-Resistant Aqueous Film Forming Foam
- ASTM – American Society for Testing and Materials
- API - American Petroleum Institute
- AWWA – American Water Works Association
- CE – Community of Europe, European Union
- CSA – Canadian Standards Association
- CUB – Central Utilities Building
- EHS – Environmental, Health, and Safety
- ESFR – Early Suppression Fast Response, also known as Storage sprinklers
- FACP – Fire Alarm Control Panel
- FDC – Fire Department Connection
- FEMA – Federal Emergency Management Agency
- FM – FM Global (Insurance)
- HAD – Heat Actuated Device
- HAZOP – Hazard and Operability study
- HFC – Heptafluoropropane
- IEEE – Institute of Electrical and Electronic Engineers
- IBC - International Building Code

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- IFC - International Fire Code
- IR – Infrared
- MCC – Motor Control Center
- MSDS – Material Safety Data Sheet
- NEC – National Electrical Code
- NEMA – National Electrical Manufacturers Association
- NFPA – National Fire Protection Association
- OSHA – Occupation Safety and Health Administration
- PFOA/PFOS - Perfluorooctanoic acid/Perfluorooctane sulfonic acid
- PED - Pressure Equipment Directive
- PSSR – Pre-Startup Safety Review
- RPZ – Reduced Pressure Zone
- UL – Underwriters Laboratory
- UPS – Uninterruptible Power Supply
- UV – Ultraviolet
- VESDA - Very Early-warning Smoke Detection Apparatus

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6.0 REFERENCES

6.1. FORMS

Form Identification	Form Name
BMS-ENG-FRM-105	<i>Design Standard Waiver Form</i>

6.2. INDUSTRY STANDARDS

- FM Global Property Loss Prevention Data Sheets
- NFPA Standards
- International Building Code
- International Fire Code
- Pressure Equipment Directive
- Seveso II Directive

7.0 REVISION CONTROL

Revision	Description	Name	Date
0	First Issue	William Gantz	09OCT2009
1	Revised per ESCR-0026	William Gantz	19Dec2011
2	Revised per ESCR-0048, ESCR-0057	William Gantz	08Jul2018
3	Revised per ECR-0168	Edward Rosario	March 2018
4	Revised per ECR-0205	Edward Rosario	March 2019
5	Revised per ECR-0288	Edward Rosario	Jun 2020

Bijlage

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**DESIGN STANDARD
for
Environmental Control Chambers**

Approvals

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1.0 PURPOSE

1.1 The purpose of engineering Design Standards (DS) program is:

- 1.1.1** To create prescriptive design standards for use by the Engineering community to respond to projects more quickly and efficiently with minimal investment in the development of design direction.
- 1.1.2** To drive common engineering design criteria across the company while incorporating flexibility where necessary for R&D.
- 1.1.3** To provide flexibility to engineers for prototyping new technologies and alternative approaches based on scale.

2.0 SCOPE

- 2.1** This Design Standard is applicable for new and renovated facilities to promote consistency in designs across BMS facilities. An applicability assessment must be performed prior to initiation of R&D projects following an established assessment process.
- 2.2** This Design Standard must be used by architects and engineers involved in new facility construction and major renovations for all facilities occupied by BMS, regardless of the owner of the building.
- 2.3** Design Standard requirements are generally accepted within the industry as proven; however, as with any design, new materials and technology must be evaluated as they become available. Any exceptions from this Design Standard must be documented and submitted as part of a Design Standard Waiver Form (BMS-ENG-FRM-105) and approved by the governing EHS and Engineering Personnel.
- 2.4** Where local laws, codes, or regulations require specific design practices which are in conflict with this Standard, local laws, codes, or regulations must prevail.

3.0 OVERVIEW

3.1 INTRODUCTION

- 3.1.1** The systems described are generally accepted within the industry as proven; however, as with any system design, new materials and technology must be evaluated as they become available. Any exceptions from this DS must be reviewed with the governing Quality Assurance Group (R&D), EHS, and Engineering Personnel. Changes to the DS must be reviewed and approved via an established change management process.
- 3.1.2** This Standard discusses the intent and considerations for environmental chambers which include stability and retain sample rooms, 20-50 Deg. C storage rooms, 2-8 Deg. C storage rooms, and 0 to -40 Deg. C storage rooms. This design

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standard describes specific considerations for the design of these room types which are generally accepted within the industry as proven; however, new materials and technology must be evaluated as they become available. The primary objective for this design standard is to provide answers to design professionals involved with BMS project designs which utilize the above room types and to minimize additional requests for information that may slow the design process.

3.1.3 The following are key design steps required during the design:

- 3.1.3.1** To define the type of system and the operational requirements of each system within the facility.
- 3.1.3.2** To design the systems that meets the design criteria with an appropriate balance of cost and risk.
- 3.1.3.3** To provide a means to control the systems so that design criteria is met.
- 3.1.3.4** To assure that the systems meet the design criteria.

3.1.4 The individual systems covered under this Design Standard document are listed below.

DESCRIPTION
STABILITY AND RETAIN SAMPLE ROOMS
20-50 DEG. C STORAGE ROOMS
2-8 DEG. C STORAGE ROOMS
0 TO -40 DEG. C STORAGE ROOMS

3.1.5 This Design Standard is not applicable to photo-stability chambers, freeze/thaw chambers and warehouse/distribution center storage areas other than refrigerators and freezers.

3.2 QUALITY CONSIDERATIONS

3.2.1 General Requirements

- 3.2.1.1** All storage areas must be of appropriate design, adequate size, and suitably located to be consistent with their intended use.
- 3.2.1.2** Sufficient space must be maintained to allow adequate air circulation.
- 3.2.1.3** All storage areas must be capable of providing alarm notification when the defined operating tolerances and alarm delays (if applicable) are exceeded.

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- 3.2.1.4** The location of the controlling sensor must be defined and justified during design of the storage area.
- 3.2.1.5** The number and placement of all continuous monitoring sensors installed in a storage area must be justified and documented within the qualification program based on the distribution (mapping) study.
- 3.2.1.6** For small refrigerators used to store drug product in warehouses / distribution centers, the monitoring sensor must have an accuracy of $\pm 0.5^{\circ}\text{C}$ and be readable from the outside.

3.2.2 Temperature and/or Humidity Requirements

- 3.2.2.1** Each storage area must have its storage condition set-point and operating tolerances specified.
- 3.2.2.2** Storage areas can have a one-component set-point, i.e., temperature-only. For a storage area with a temperature-only set-point, where humidity is monitored but not controlled, it is acceptable to define the humidity as “ambient”.
- 3.2.2.3** Refrigerator and Freezer storage conditions (including low-temperature and ultra-low-temperature freezers) have temperature-only set-points. These areas do not require monitoring of humidity.
- 3.2.2.4** Stress stability storage conditions have temperature-only set-points and do not require monitoring of humidity.
- 3.2.2.5** Storage areas with a two component set-point must specify both components, i.e., temperature and relative humidity.
- 3.2.2.6** The target set-points and operating tolerances for refrigerators and freezers are listed in Table 3.2.1.

TABLE 3.2.1: Refrigerator and Freezer Temperature Setpoints

Storage Area	Target Temperature Set-point	Tolerance
Refrigerator	5°C	$\pm 3^{\circ}\text{C}$
Freezer	-20°C	$\pm 5^{\circ}\text{C}$
Low-temperature Freezer	-40°C	$\pm 10^{\circ}\text{C}$
Ultra-low-temperature Freezer	-80°C	$\pm 10^{\circ}\text{C}$

- 3.2.2.7** The operating tolerances for stability storage areas as defined by the International Conference on Harmonization (ICH) must be utilized

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unless local regulation and/or the filed approved post-approval stability protocol require different tolerances.

- The target set-points and operating tolerances for refrigerators and freezers used for stability storage are listed in Table 1.

3.2.2.8 The target set-points and operating tolerances for all other stability storage areas are listed in Table 3.2.2.

TABLE 3.2.2: Stability Storage Temperature Setpoints

Storage Area	Temperature / Humidity Set-point	Tolerance
Marketed Product and Premarket Program Conditions		
Zone II Long-Term	25°C / 60%RH	± 2°C / ± 5%RH
Zone IVA Long-Term	30°C / 65%RH	± 2°C / ± 5%RH
Zone IVB Long-Term	30°C / 75%RH	± 2°C / ± 5%RH
Accelerated	40°C / 75%RH	± 2°C / ± 5%RH
Premarket Program Only Conditions		
Zone II Low Humidity	25°C / 40%RH	± 2°C / ± 5%RH
Zone IV Low Humidity	30°C / 35%RH	± 2°C / ± 5%RH
Accelerated Low Humidity	40°C / 20%RH	± 2°C / ± 5%RH
Shipping	60°C / 75%RH	± 2°C / ± 5%RH
Stress	50°C	± 2°C
High Stress	70°C	± 2°C

3.2.2.9 The target set-points and operating tolerances for refrigerators and freezers used for retain storage are listed in Table 3.2.1.

3.2.2.10 The target set-point and operating tolerances for room temperature retain storage areas are listed in Table 3.2.3.

TABLE 3.2.3: Retain Storage Temperature Setpoints

Storage Area	Temperature / Humidity Set-point	Tolerance
Room Temperature	22°C / Ambient RH	15°-30°C / ≤ 55%RH

3.2.3 Identification

3.2.3.1 A listing must be maintained for each type of storage area (e.g., stability, retain) defining all of the available storage conditions including the set-point, operating tolerances, and all other

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appropriate identifying information.

3.2.3.2 The exterior of each storage area must properly identify the storage condition set-point.

3.2.3.3 The interior of each storage area must be defined and organized in such a way as to provide for accurate sample retrieval, inventory control, and proper identification of monitoring points during qualification activities.

3.2.4 Alarms

3.2.4.1 All storage areas must be equipped with an alarm system to provide notification to authorized and/or informed personnel when storage conditions exceed their defined operating tolerances (and alarm delays, if applicable) so remedial action can be taken.

3.2.4.2 In the event that the automated monitoring and call-out system is not functioning, then manual monitoring will be necessary (e.g., periodic review of chart recorders)

3.3 EHS CONSIDERATIONS

3.3.1 In order to ensure that appropriate safeguards to mitigate risks to personnel are provided, a structured hazard review must be conducted. The hazard review team should include members from engineering, operations and EHS. The review must include, but not be limited to the following:

- Emergency Alarming and egress
- Hazardous Storage, including electrical classification designation(s) and fire detection and suppression
- Odor Control

3.3.2 All walk-in chambers require Personnel Emergency Alarm (P.E.A.) with reset type, electrically powered “man down” emergency alarm system, with local and remote annunciation. Local alarm, audio/visual type, must be located outside of cold room/freezer, close to an entrance; while remote alarm must report to a 24-hour-manned security monitoring station.

3.3.3 P.E.A. door opening actuator must be a heavy duty, oil-tight lighted switch, marked "EMERGENCY ALARM" in the country's primary language only. The actuator must be mounted on the interior wall of the cold room adjacent to the door safety release button 32" above finished floor.

3.3.4 If an assessment of the space determines that odors are a concern then the use of carbon containers within the space to limit or eliminate odors shall be

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considered.

- 3.3.5** If an assessment determines that the storage containers themselves are not appropriate for secondary containment then other considerations for containment shall be investigated.
- 3.3.6** If floor drains are determined to be necessary for the space then all drains shall be provided with glycol filled traps.
- 3.3.7** If Hazardous materials are to be stored in the room than an electrical classification assessment shall occur to determine the appropriate space rating.
- 3.3.8** All environmental controls chambers used to store flammable materials shall comply with the requirements of BMS corporate directive BMS-OCD-3kS4 (006973) Occupational Health and Safety Standards Manual section 17 Electrical Equipment in Hazardous (Electrically Classified) Locations (BMS-CD-004-S10) Flammable and Combustible Liquids (BMS-CD-004-S11), and Ergonomics (BMS-CD-004-H10).

When flammable materials are to be stored in a reach-in environmental control chamber (e.g., lab refrigerator/freezer), then the chamber shall be appropriately classified for the storage of flammable materials.

When flammable materials are to be stored in a walk-in environmental control chamber, the following apply:

- 3.3.8.1** The electrical components of the chamber must meet all applicable codes and have the required national testing and certifications that ensure minimum safety requirements relevant for the location of installation.
- 3.3.8.2** The electrical components of the chamber shall, at a minimum, be electrically classified (e.g. Class 1, Div.2 Groups C/D in U.S. installations) per the storage intentions .
- 3.3.8.3** The standard chamber shall have 1-hour fire rated walls for segregation from other structures should be used for ordinary non-flammable storage. A 2-hour fire rated wall for segregation from other structure must be used for flammable storage.
- 3.3.8.4** The insulation system shall be FM approved.
- 3.3.8.5** The design of the chamber shall address requirements for spill containment.
- 3.3.8.6** The chamber shall be capable of automatically going to 100% ventilation in the event of a spill.

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3.3.9 All environmental room doors will include an illuminated Push Button (“Mushroom”) Safety Release which will override the door locking mechanism from inside.

3.3.9.1 Push Button will be mounted on the door at 32” above the floor and requires signage indicating “Door Safety Release”.

3.3.10 Provide vision panels with stainless steel frames in all doors. Glazing must consist of two panels of safety glass with a sealed, argon insulated space between each panel.

3.3.11 Vision panel must be flush mounted and removable.

3.3.12 Vision panels must be heated to prevent condensation.

3.3.13 Freezer Storage or near freezing storage applications require Anti-sweat Heater Wiring.

3.3.14 Heater wires must be concealed behind the metal edge of the doorjamb on all four sides. An additional heater must be concealed beneath the exterior edges of the door around the perimeter to provide sufficient heat to prevent condensation and frost formation and freeze-up of door seals.

3.3.15 Lighting controls must be wall mounted and located outside the room adjacent to the door handle at 42” above floor.

3.3.16 Light switch must be labeled “COLD ROOM LIGHT”, “FREEZER LIGHT” or “ENVIRONMENTAL ROOM LIGHT” accompanied with the label “LIGHT MUST BE ON PRIOR TO ENTRY” in the country’s primary language only.

3.3.17 When automated or manual sliding doors are required for environmental rooms, a 36" wide x 84" high (914mm wide x 2133mm high) manually operated emergency egress man door (swing-type) must be provided adjacent to any sliding door and must swing out of the environmental chamber. For hazardous rooms (H Classification Per IBC), when required to have three or less occupants, only (1) one means of egress is required. When (4) four or more occupants are required inside the room, (2) two means of egress shall be required. Two egress doors shall be placed in approximate opposite ends of the room to minimize egress travel path distances.

3.3.18 All storage racking and/or shelving shall be anchored to the wall system.

3.3.19 Mechanical components must be located in an accessible location such as a mechanical room. If components are located on top of the chamber it must be designed to support the equipment and live loads. All components shall be provided with OSHA, or applicable code, compliant safe guards and access.

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Egress routes shall be maintained from these areas and shall be accessible via stair, floor man-ladder (with cage if required), If the the structural load / configuration of any equipment is technically infeasible to be supported by the environmental chamber's structural envelope, the use of an interstitial and/or catwalk connection for top access must be used.

3.4 REDUNDANCY/RELIABILITY CONSIDERATIONS

- 3.4.1** The room lighting and PEA safeguards (as required), including lighted activation buttons, must be on the emergency power system. The PEA safeguard system and the door safety release system must have an uninterruptible power supply (UPS).
- 3.4.2** Mechanical components – fans, compressors, condensers, heaters, etc. - must be on the standby power system and must automatically restart when power is restored following an interruption.
 - 3.4.2.1** When multiple environmental chamber with similar environmental design condition are within close proximity, the number of rooms required to have mechanical systems fed by standby power should be determined via a risk assessment. This will require that an SOP be put in place that addresses the value of materials stored and a strategy for managing the rooms so that materials may be expeditiously transferred to standby-power-fed rooms in the event of a loss of normal power.
 - 3.4.2.2** Consideration should be given to locating Mechanical components outside of the storage room in a location that is easily accessible for maintenance purposes.
- 3.4.3** The room control system must be powered from a UPS source or must have an integral battery backup capable of 72 hours of continuous operation.
- 3.4.4** For high value product storage (determined via a risk assessment), a back-up method of temperature control shall be provided that shall automatically be engaged in the event of a failure of the primary method of temperature control. The back-up temperature control method shall be independent from the primary, and its ability to control temperature shall not be compromised by failure of the primary temperature control method.
- 3.4.5** Redundancy for mechanical systems must be based on a risk assessment that factors in the value of the product and the availability of alternate storage rooms in the event of a failure.
 - 3.4.5.1** If the risk assessment determines that Nx2 redundancy is required for

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storage rooms having single compressors and evaporators the following shall be provided: Independent redundant refrigeration circuits including compressors, condensers, evaporators and refrigerant piping, each sized for 100 percent of the cooling load and capable of stand-alone operation shall be provided. Include controls for lead/lag alternating operation and automatic switch-over upon failure of the active circuit.

- 3.4.5.2** If the risk assessment determines that N+1 redundancy is required for storage rooms having multiple compressors, condenser fans and evaporator fans the following strategy shall be utilized: the failure of any one component, e.g. compressor, will not degrade the performance of the system. Provide automatic lead/lag operation and automatic isolation and switchover upon failure of the active components.

3.5 GENERAL DESIGN CONSIDERATIONS

- 3.5.1** The environmental room design and installation must conform to applicable codes, ordinances and regulations governing the use and safety of refrigerants including, but not be limited to ASHRAE/ANSI standard 15, ARI 420, ARI 520, ANSI B9.1, and NEC.
- 3.5.2** In order to maintain the environmental chamber's interior performance requirements, allowances for door opening control into the chambers must be met to avoid alarms and/or deviations associated with chamber breach. An assessment shall be performed to determine the allowable alarm limits based on the actual operation of the space. Automated and manual man (swing type) doors shall be fitted with a door closer which is capable of overcoming air pressures presenting themselves during an open door event. Automated (power actuated) sliding doors shall stay open by the hardware operator device for no less than thirty (30) seconds and shall be adjusted.
- 3.5.3** When environmental chamber doors are open and exposed to the ambient environment outside, the chamber must maintain the required performance levels. In order to provide a basis for the design, the time and frequency requirements for opening of doors to the space must be provided.
- 3.5.4** Temperature and humidity sensor locations and quantities must be defined during the testing/verification period to ensure temperature and humidity (if applicable) uniformity during various operational conditions (i.e. doors open and doors closed). At a minimum one additional temperature and humidity (if applicable) transmitter shall be specified to be located near the entry doors.

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3.5.5 All interior surfaces including walls, doors and mechanical and electrical components must be compatible with anticipated cleaning solutions.

3.6 ARCHITECTURAL DESIGN CONSIDERATIONS

3.6.1 PANEL DESIGN

3.6.1.1 Environmental chamber room panels must be constructed of prefabricated modular sectional panels consisting of walls, floor, ceiling, etc., with a thermal conductivity factor (K) of not more than 0.14 BTU per hour per square foot for 1" (2.54 cm) thickness per degree Fahrenheit (0.02 watts per meter per degree Kelvin). Overall wall thickness must be four inches (4") (10.16 cm) mechanically locked in place, from the interior. The panels must be constructed of metal double-walled pans, with foamed-in-place urethane or polyisocyanurate insulation using Montreal Protocol accepted non-toxic, non-flammable fluorocarbon blowing agents which bind and forms a rigid panel unit without additional support. The panel edges must assure an airtight vapor proof joint when assembled. Reinforcement must not violate the insulation value of the panels. The resulting cured foam must be an odorless closed-cell product and must not emit or outgas the fluorocarbon blowing agent. Where building columns occur within chambers furring of the columns with paneling should be evaluated.

- Rated U-Factor: 0.0294.
- R-Value: Not less than R34.
- Minimum compressive strength of 28 pounds per square inch (0.193 MPa) for walls and ceilings.
- Flame Spread Rating: 25
- Smoke density no greater than 450 (ASTM E-84).

3.6.1.2 Panel construction must be interchangeable panels, FM approved and UL labeled and must comply with applicable Building Code requirements for foam plastic materials, designed for quick assembly, consisting of interior and exterior metal pans accurately formed with metal dies and checked with gauges for uniformity. Tongue and groove interfaces to assure a tight joint. Provide flexible vinyl gasket on interior and exterior of each panel along each tongue edge to provide sealing at each joint.

3.6.1.3 Do not use batten strips, pressure clips, or other fastening hardware for covering joints or joining panel sections. All joints between the

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panels will be sealed to provide a vapor-tight seal.

- 3.6.1.4** Panel faces for interior and exterior surfaces at wall and roof (ceiling) panels must be 0.04 inch, minimum, thick embossed metal. Interior and exterior walls and interior roof panels must be modified epoxy enamel. The exposed interior finish must be selected from the manufacturer's standard color charts and the exposed exterior finish must be 1 mill minimum thickness. Non-exposed areas must be a natural finish.
- 3.6.1.5** Panels must be fitted with a locking device which consists of self-contained, interior cam-lock fasteners locked and released with a single hex wrench tool. Provide closure panels, matching materials, colors, and finishes of adjacent panel material, to fill in between building and environmental chamber. Provide filler panels on exposed faces of rooms from top of room to finished ceiling line, and elsewhere as required presenting a neat, finished installation. Baked epoxy finish on filler and fascia panels must match room panel finish.
- 3.6.1.6** Cleaning solutions, solvents, and process chemicals must be coordinated with the Vendor to ensure the wall panel surface finish will not break down or degrease. This includes but is not limited to peeling, cracking, and staining.
- 3.6.1.7** Provide access ports for all service line penetrations into each walk-in, include fire protection piping penetration and monitoring wiring. Pack opening around penetration with foamed-in-place urethane, and seal with silicone caulking. Do not penetrate panels at panel joints. All circular penetrations must be sleeved PVC to ensure no through metal resulting in condensation. All material for penetrations must be reviewed by FM.
- 3.6.1.8** Walk-in chambers are to be self supporting. The roof structural system must be capable of supporting room equipment loads including man-loads for maintaining equipment. Chambers are not to be supported from building structure.
- 3.6.1.9** The ceiling assembly must be designed to support the weight of equipment and maintenance personnel. Signage shall be provided indicating the design load capacity of the ceiling assembly. Provide OSHA, or local code or agency,-compliant railings and an access stair or ladder (provide ladder cage when over 20 ft. high). Where personnel access is required on top of chamber, provide 42" high

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min.

3.6.1.10

3.6.2 Doors & Hardware

- 3.6.2.1** Generally, doors must be in-fitting, flush mounted and constructed similar to wall panels. Door Construction must be similar to the wall panel construction and must be the fitted, flush mounted type.
- 3.6.2.2** For small walk-in chambers, manually operated manufacturer's supplied standard insulated door(s) must be used, of the type and size indicated, complete with frame, hardware and accessories. Door construction, materials, and finishes must be the same as specified for wall panels. Threshold for door must be low profile. Self-closing type with durable stainless steel pins and self-closing nylon cams. Provide a minimum of three hinges for these types of doors.
- 3.6.2.3** Door Hardware must be chrome plated and must have three (3) hinges and one (1) latch. The latch must be of the safety type with an inside release arm to prevent personnel from being accidentally locked in. The door latch must contain a key locking device.
- 3.6.2.4** A risk assessment must be utilized to determine if the storage room door hardware requires card reader access.
- 3.6.2.5** For larger walk-in chambers, manually operated doors may not be enough. If storage racks are utilized which require means of retrieval by forklifts entering the walk-in chamber (in rack sprinkler and/or Early Suppression Fast Response (EFSR) type fire suppression systems) power sliding doors must be integrated where possible.
- 3.6.2.6** Powered sliding doors must be insulated and designed as a single or double-leafed sliding door mounted to wall panels. Doors must automatically open with push button activation located adjacent to the door or remote fork truck door opener. Door must remain open for 30 seconds (adjustable) or as long as there is interference with the threshold beam.
- 3.6.2.7** Gasket: Vinyl type with magnetic steel core. Provide gaskets on both sides and top of door. Provide adjustable rubber wiper gasket on bottom of door. Provide gasket with enough magnetic force to form positive airtight seal.
- 3.6.2.8** Hardware: Heavy-duty door hardware with keyed lock cylinders and

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padlock latches into door latch and handle assemblies.

3.6.2.9 Door Handle and Latch Assembly: Automatic closing type. Provide safety release mechanism on inside of room preventing personnel from being locked from outside.

3.6.2.10 Heated Gasket: Low voltage heater built into perimeter of jamb to prevent door from accumulating ice and freezing temperatures (both door and frame). Include adjustable thermostatic control gasket with a magnetic steel core on doorframe.

3.6.2.11 Arrange door trim and seals to comply with National Sanitation Foundation (NSF) requirements for Seal of Approval.

3.6.2.12 Window: Double-layer, removable heated thermal pane window mounted in door with a minimum viewing area 12" x 12".

3.6.3 Floors

3.6.3.1 An evaluation of the floor loading shall occur based on the materials to be stored and the storage type (i.e. pallet on floor, floor mounted shelves, racks, etc.) to determine the proper floor loading design criteria.

3.6.3.2 All storage room floors shall be at the same level as the surrounding floor surface. If insulated floors are required, the floors shall be recessed into the slab so that a ramp is not required for access.

3.6.3.3 Provide sealing strips at the exterior of environmental room walls and floor, provide sealing strips between environmental room walls and floor and adjacent building walls and floor to prevent air infiltration and environmental losses.

3.6.3.4 Flooring must be smooth, free of ribs or patterns. Wear characteristics must exceed rubber and flooring must require no maintenance except cleaning with detergent and water.

3.6.3.5 Apply a non-skid coating to cover floor surface.

3.6.3.6 The floor finish will be applied at the existing floor level, with the exception of the 0 to -40 deg. C and high humidity Storage Rooms and will not require any chamber floor elevation change.

3.6.4 Ceilings

3.6.4.1 Where multi-tiered storage racking is used in combination with multiple aisles, the walk-in room may exceed the ability for the ceiling to support itself. Walk-in rooms will require additional

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coordination between the designer and the racking expert to assure proper alignment of rack/aisle and ceiling support locations. In no circumstance must the walk-ins be connected to the buildings shell. The top of the vertical racking posts must be fitted with circular bearing plates designed to support the walk-in room ceiling. Racking supports must be sized to support roof loads, equipment loads, man loads, pallet loads and any other items necessary for the walk-ins.

3.6.4.2 When an environmental chamber requires a long span too far for the ceiling to support itself, the environmental manufacturer must supply a turn-key solution in the form of supplementary wall and ceiling steel framing to support the ceiling load. This framing will be outboard of the chamber's interior and should not interfere with the performance of the chamber. This solution also applies to environmental rooms that require MEP equipment to be hung from the chamber's ceiling as deemed to be a structural concern. Free standing structural members inside the chambers shall be avoided when possible. Racks must not be used as a means to support the ceiling,

3.6.4.3 Ceiling panel surface finishes must be selected to ensure cleaning solutions, solvents, and process chemicals relative to the project will not break down or degrease the finishes. This includes but is not limited to peeling, cracking, and staining.

3.6.5 Special Considerations

3.6.5.1 When designing wide span environmental chambers that require pallet storage racking and have the inability to independently/structurally support the chamber's ceiling, racking is permissible to be used as a structural component to support the wide span chamber ceiling. This is done by providing 2' diameter min., structurally loaded rounded plates affixed to the top ends of designated (main) racking posts.

3.6.5.2 When pallet racking is utilized for multi-tiered storage inside environmental rooms, the same sprinkler / stored material clearances for EFSR and in-racking storage apply. Sprinkler, racking, and pallet-material clearances must be in accordance with DS-2500 PACLAW Standard.

3.6.5.3 When installed, environmental chambers shall be seismically braced to meet the governing jurisdiction requirements.

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3.7 LIGHTING & ELECTRICAL SYSTEM DESIGN CONSIDERATIONS

3.7.1 Lighting

3.7.1.1 Lighting must be in accordance with DS-2010 Lighting Standard.

3.7.1.2 All light switches shall be provided with a timer.

3.7.1.3 All lights shall turn on immediately; lights that require a warm up period are not permitted.

3.7.2 Electrical

3.7.2.1 Electrical must be in accordance with DS-2015 Building Power Distribution Standard.

3.7.2.2 Electrical conduits penetrating the room must be sealed at the room boundary to prevent ingress of condensation.

3.7.2.3 No electrical outlets shall be provided within the Stability or Storage Rooms.

3.8 FIRE PROTECTION AND ALARM DESIGN CONSIDERATIONS

3.8.1 Fire Protection and alarm must be in accordance with DS-2030 Fire Protection Standard and with DS-2005 Auxiliary Systems Standard.

3.8.2 All walk-in storage rooms shall be protected by an automatic fire suppression system except for freezer rooms which will use fast detection smoke detection systems.

3.8.3 Alarm and indication equipment such as smoke detectors, heat detectors, horns and strobes must be rated for the applicable environmental conditions (temperature and humidity) in which they will be placed.

3.8.4 The storage value in a single walk-in chamber should be considered to reduce business risk.

3.8.5 For Walk-In Freezers, fire alarm equipment must be evaluated for operation within the environmental ranges. Smoke detectors must be evaluated for operation within the environmental ranges.

3.9 AUTOMATION & INSTRUMENTATION SYSTEM DESIGN CONSIDERATIONS

3.9.1 General

3.9.1.1 Automation and Instrumentation must be in accordance with DS-2045 Automation & Instrumentation Standard.

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- 3.9.1.2** Each environmental room must have a stand-alone microprocessor or PLC based control system to control, monitor and record all aspects of the room operation.
- 3.9.1.3** Control components must be located in a key-lockable NEMA enclosure. An analysis should occur based on the location and environment of the panel to determine which number NEMA rated cabinet is required with its corresponding Ingress Protection (IP) Equivalency Rating. The enclosure must be mounted on the front exterior wall of the room.
- 3.9.1.4** The human-machine interface (HMI) must consist of, as a minimum, an alphanumeric keypad with an LCD display screen. Operator access must be password controlled.
- 3.9.1.5** The default display on the LCD screen must show the following information:
 - 3.9.1.5.1** Room temperature at the controlling sensor
 - 3.9.1.5.2** Room temperature at a second sensor located near the door
 - 3.9.1.5.3** Room relative humidity (for humidity controlled rooms)
 - 3.9.1.5.4** Mechanical system status: ON or OFF
 - 3.9.1.5.5** Common alarm status: NORMAL or TROUBLE
- 3.9.1.6** There must be visual and audible alarms at the control panel to indicate the following conditions:
 - 3.9.1.6.1** Personal Emergency Alarm (PEA)
 - 3.9.1.6.2** Loss of normal power
 - 3.9.1.6.3** Temperature excursions.
 - 3.9.1.6.4** Humidity excursions.
 - 3.9.1.6.5** Door open (with user-adjustable time delay)
- 3.9.1.7** The Building Automation Systems BAS or the preferred local monitoring system, as applicable for the project, must continuously monitor the environmental room storage conditions, operating status and alarms through an interface with the local room control panel.
 - 3.9.1.7.1** The preferred interface is a network connection from the local control panel into the nearest primary DDC

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controller or floor level network controller.

3.9.1.7.2 The minimum acceptable interface would consist of hardwired I/O from the local panel to a dedicated primary DDC controller on the BAS Ethernet.

3.9.1.7.3 Historian data must reside in the BAS server or other dedicated historian server.

Considerations must be made to determine if continuous video surveillance of the room entry door is required, based on the level of business risk, for storage rooms containing high value service or controlled substance, e.g. cell bank storage.

3.9.2 Instruments

3.9.2.1 Analog temperature sensing instruments must be platinum RTD type with an integral transmitter producing an industry standard (4-20 mA DC, 0-5V, 0-10vdc, etc) linear output.

3.9.2.2 All instruments must be calibrated to NIST traceable standards (or Regional Equivalent) and must have the capability to be periodically recalibrated.

3.10 MECHANICAL SYSTEM DESIGN CONSIDERATIONS

3.10.1 Design Conditions

3.10.1.1 Mechanical systems must be in accordance with DS-4301 HVAC Standard and DS-4101 Facility Utilities Standard.

3.10.1.2 For sizing refrigeration system, use the normal expected indoor conditions surrounding the exterior of the room enclosure.

3.10.1.3 Environmental rooms, e.g. cold labs, where personnel will be in the chamber other than to drop off or remove products or samples, must have ventilation air in accordance with code (generally 20 CFM per person). The room must be designed with a duct collar connection from a source of tempered outside air, and an exhaust fan or duct collar connection to an exhaust air system.

3.10.1.4 Basis of design for environmental room must include the following considerations:

3.10.1.4.1 Anticipated mass of storage including temperature and moisture of stored product

3.10.1.4.2 Anticipated mass of incoming material during design

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time period, e.g. 8 hours, and the temperature and moisture content when the material arrives

3.10.1.4.3 Anticipated mass of outgoing material during design time period, e.g. 8 hours

3.10.1.4.4 Number of door openings during design time period, e.g. 8 hours

3.10.1.5 Environmental chambers, especially cold rooms and freezers, are sometimes fitted with architectural panels that extend the sides of the room up to the structure above, for cleanliness or appearance reasons. If there is a roof above, consider the summer and winter temperature extremes that may occur in this plenum. Provide ventilation to limit summertime temperatures and provide unit heater(s) or other means to protect pipes from freezing during winter conditions.

3.10.1.6 If the environmental room has air-cooled refrigeration systems that reject their condenser heat to indoors, provide cooling as required to maintain the equipment space at the ambient temperature selected for the condensing unit.

3.10.1.7 Room interior noise levels must not exceed 85 dB(A), including noise generated by the room mechanical systems but excluding noise generated from adjacent spaces or equipment. Noise levels generated by mechanical equipment located outside of the cold room must comply with the adjacent noise criteria acceptance levels but at no time shall exceed 85 dB(A). For administrative and laboratory areas the sound levels shall not exceed 65dB(A).

3.10.2 Refrigeration Systems

3.10.2.1 Refrigeration piping must be three-pipe systems that utilize hot gas for coil defrost or a separate electric heater defrost (preferred choice for reliability). Chamber must maintain conditions within design uniformity limits during defrost cycle.

3.10.2.2 Refrigerants must be non-CFC, non-HCFC types having a zero Ozone Depletion Potential (ODP) and low Global Warming Potential (GWP). Examples include R404A, R407 series (R407A through 407E), and R410A refrigerants.

3.10.2.3 Air-cooled condensing units are commonly located outdoors. Systems with water-cooled condensers may be located indoors if a

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reliable source of cooling water is available and are preferred for efficiency and maintainability.

- 3.10.2.4** Blower coil units in cold rooms and freezers are best located above aisles along opposite walls of the room. Optimal temperature uniformity is obtained when the air discharge patterns are not disrupted by pallet locations on the upper tier of the racks. Consider protection from fork trucks and pallets during lifting and stacking operations.

3.10.3 Heating Systems

- 3.10.3.1** Heating for warm rooms is most commonly provided by a hydronic heating coil in a small air handling unit above the enclosure. The air handling apparatus may also be remotely located with ductwork connecting the unit to the room.
- 3.10.3.2** Verify that a reliable source of heating hot water is available at all times, including during a loss of normal power.
- 3.10.3.3** If there is no heating hot water available, electric resistance heating is an acceptable alternate. The output of the heater must be modulating (SCR controlled).

3.10.4 Humidification Systems

- 3.10.4.1** Where humidification is required for environmental rooms, a panel type steam dispersion humidifier must be provided in a small air handling unit located above the room or remotely with connecting ductwork.
- 3.10.4.2** Steam quality will be Utility Steam except when Environmentally Classified for cleanliness. Classified or Controlled Non Classified with Local Monitoring requires chemical free steam. For chemical free steam, 304 series stainless steels must be used.
- 3.10.4.3** If steam is not available, environmental chamber manufacturers have the capability to provide stand-alone steam generators. A suitable water source will be required.

3.10.5 Dehumidification Systems

- 3.10.5.1** Humidity controlled rooms with dewpoints above 5°C can usually be dehumidified using the evaporator coils with hot gas reheat. This method is the least costly to implement and consumes the least amount of energy but is limited to approximately 90% relative

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humidity non-condensing.

3.10.5.2 Humidity controlled rooms with dewpoints below 5°C will require a desiccant wheel dehumidifier. This design will require a regeneration air intake and exhaust ductwork and medium or high pressure steam for regeneration. These units have integral PLC-based controls that are integrated into the room controls; this is the room manufacturer's responsibility.

4.0 SYSTEM DESIGN BASIS

4.1 20-50 DEG. C STORAGE ROOMS

- 4.1.1** Temperature uniformity within the chamber (i.e. at locations where samples will be stored) must be $\pm 2^{\circ}\text{C}$ from setpoint.
- 4.1.2** Some refrigeration will be required, otherwise the heat added by the blower fan and lights will put the room above design setpoint. If reliable sources of chilled water and heating hot water are available (i.e. during loss of normal power), warm rooms are best served by a four-pipe fan coil unit with a chilled water cooling coil and hot water heating coil.
- 4.1.3** The preferred location for the mechanical apparatus is on top of the room enclosure or in a mechanical room. Warm rooms with mechanical system located inside the room in a ceiling plenum should be avoided due to the requirement for maintenance personnel to enter the room to perform maintenance.

4.2 2-8 DEG. C STORAGE ROOMS

- 4.2.1** Temperature uniformity must be $\pm 3^{\circ}\text{C}$ from setpoint (including defrost cycle and door openings for entrance and exit as indicated herein).
- 4.2.2** Humidification is not applicable.
- 4.2.3** Dehumidification is not common for cold rooms, but may be required by the user if the stored product is hygroscopic. Dehumidification is also prevalent in locations having high ambient RH levels where mold formation is an issue. Desiccant wheel type dehumidification must be utilized, and RH uniformity must be $\pm 10\%$ RH. It must be noted that dehumidification will preclude the need for coil defrost except during upset conditions caused by a malfunctioning dehumidifier.

4.3 0 TO -40 DEG. C STORAGE ROOMS

- 4.3.1** Temperature uniformity must be $\pm 10^{\circ}\text{C}$ from setpoint (including defrost cycle and door openings for entrance and exit as indicated herein).

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- 4.3.2** Humidification is not applicable.
- 4.3.3** Floor panels of similar construction to wall panels must be installed in freezer room and or all other rooms qualified for thermal protection and separation. Floor panels must be a minimum of 3" thick, and must be reinforced for loads up to 600 PSF, or as noted. When multi-tier storage racking is required, design floors for 600 pounds per square foot distributed load weight and a post load plate to be coordinated with the rack manufacturer (walk-in freezer room only). Where forklift traffic is utilized in freezers, interior floor surface must be heavy gauge diamond plate flooring.
- 4.3.4** It is preferred to create a recessed floor slab condition at the freezer's footprint. The recessed floor slab depth shall be coordinated with the storage room vendor's floor design to assure flush elevation at all adjacent areas. A vapor barrier shall be provided to assure the prevention of slab heaving. If constructability concerns deem this design is technically infeasible to provide such as recessed floor slab condition, it is permissible to provide a raised floor assembly with the utilization of a ramp(s).
- 4.3.5** Interior ramps for walk-in storage rooms must be full width of door plus an additional 12 inches on each side of door. Because the interior ramp compromises the floor insulation, strip heating coils must be provided under the ramp to prevent heaving of the concrete floor slab. Exterior ramps are permitted when floor area and an ergonomic and material handling study has been completed. The study must assure traffic is not impeded, inclines are of a safe design (as compared to the operating intent and material handling equipment use), and the ramp finish provides an acceptable walking/working surface (e.g. acceptable co-efficient of friction). Providing ramp guardrails is optional and may be required as a result of the ergonomic study. Freezer floor ramps must be finished and installed by the environmental room manufacturer. All materials and finishes must be the same as fabricated rooms unless determined otherwise via ergonomic and material handling study.
- 4.3.6** 4 Deg. C (39F) cold room anterooms must be adjacent to entry points into freezers designed for -20 Deg. C or below.
- 4.3.7** When 0 to -40 Deg. C storage rooms need to be located above the ground floor level, a slab depression must be created to allow for the insulated floor slab to remain flush with the surrounding floor. If this is not possible, a ramp will be required and determined acceptable via ergonomic and material handling study. Special consideration of floor vapor barriers will need to be taken to assure the avoidance of condensation build up within the elevated slab. Mechanically fasten rigid insulation of the minimum R-Value of 20 to the underside of the

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elevated slab encompassing the freezer footprint plus an additional 24" offset past the freezer footprint perimeter. If depressing the elevated slab is desirable, it is imperative that the elevated slab is designed in a way which can structurally support the freezer.

- 4.3.8** Doors must be provided with doorframe heater to prevent frost build-up on door and viewing window. Perimeter and frame: hard anodized aluminum with double gasketing on three sides and wiper gasket on bottom.
- 4.3.9** Special attention must be paid to the design of the Mechanical systems surrounding the room so that they are sized properly to control the ambient environment on the outside of the rooms.

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5.0 APPENDIX

5.1 Acronyms

- ASHRAE - American Society of Heating, Refrigerating & Air-Conditioning Engineers
- ANSI - American National Standards Institute
- ASTM - American Society for Testing and Materials
- ESFR – Early Suppression Fast Response
- FM – Factory Mutual
- GWP - Global Warming Potential
- ICH - International Conference on Harmonization
- IBC – International Building Code
- NEC – National Electrical Code
- NEMA – National Electrical Manufacturers’ Association
- NRTL – Nationally Recognized Testing Laboratory
- NSF - National Sanitation Foundation
- OSHA - Occupational Safety and Health Organization
- ODP - Ozone Depletion Potential
- P.E.A. - Personnel Emergency Alarm
- SMACNA - Sheet Metal and Air Conditioning Contractors' National Association

6.0 REFERENCES

- SMACNA Testing, Adjusting & Balance Handbook
- FM Global Property Loss Prevention Data Sheets
- NFPA Standards
- International Building Code
- ANSI Standards
- ASHRAE Standards

7.0 REVISION HISTORY

REVISION	DESCRIPTION	NAME	DATE
0	FIRST ISSUE	WILLIAM GANTZ	22-JUN-2011
1	REVISED PER ESCR-0071 AND ESCR-0072	ROBERT DAVIS	17-JAN-2014
2	REVISED PER ESCR-0108	ROBERT DAVIS	APR 2014
3	REVISED PER ESCR-0270	EDWARD ROSARIO	SEP 2020

Bijlage

6 UPD sprinklerinstallatie, uitgangspunten document



Programma van Eisen

Betreffende de sprinklerbeveiliging in het complex:

**Bristol-Myers Squibb Company
Willem Enthovenstraat
Oegstgeest**

Status: Versie 8
Datum: 9 juni 2021

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Bijlage(n):

1. Situatietekening.
2. Enkele passages uit FM 8-9

Disclaimer:

Dit PvE kan eerst worden aangemerkt als definitief nadat het door een erkende inspectie-instelling en de eisende partijen is gevalideerd c.q. goedgekeurd.

De verschillende versies van dit PvE zijn chronologisch oplopend genummerd. Er dient te worden geverifieerd of de meest recente versie wordt gehanteerd. Hiertoe kan contact worden opgenomen met de opsteller van dit PvE.

1 INLEIDING

Dit Programma van Eisen (PvE) betreft de sprinklerbeveiliging in nieuwe complex van Bristol-Myers Squibb Company te Oegstgeest en dient als Uitgangspuntendocument (UPD) voor het certificeringstraject.

De sprinklerbeveiliging moet worden gecertificeerd conform de laatste versie van het CCV Inspectieschema Brandbeveiliging (inspectiecertificaat, ten minste jaarlijkse inspectie).

Hiertoe moet de sprinklerbeveiliging voldoen aan de betreffende sprinklervoorschriften en worden goedgekeurd door een NEN-EN-ISO/IEC 17020 type-A geaccrediteerde inspectie-instelling.

Bij het opstellen van dit PvE zijn o.a. onderstaande gegevens gehanteerd:

- Project Report Index-Rec No: NE6220.00-04 van FM Global
- Indelingstekeningen WIP_12-02-21
- Toetsing brandveiligheid Bouwbesluit van moBius consult.

In dit PvE zijn de eisen/wensen verwoord van de opdrachtgever en het bevoegd gezag. Tevens zijn de schadepreventie aanbevelingen opgenomen van de verzekeraar (FM-Global) voor zover deze aanbevelingen betrekking hebben op de uitvoering van de sprinklerbeveiliging.

De afgeleide doelstelling van de sprinklerbeveiliging is een beginnende brand in een vroeg stadium detecteren, signaleren en onder controle houden zodat het bestrijden ervan door de interne en externe brandbestrijdingsorganisaties kan plaatsvinden waardoor schade wordt beperkt, binnen de context van het basisontwerp.

Daarnaast is de sprinklerinstallatie bedoeld voor het realiseren van functiebehoud van elektrische bekabeling zoals bedoeld in NPR2576, voor de sprinkler-, brandmeld- en ontruimingsalarminstallatie in ruimten waarin sprinklers met een aanspreektemperatuur van max. 100 °C zijn toegepast.

Aangezien de sproeitijd op wens van de opdrachtgever 120 minuten bedraagt wordt de sprinklerinstallatie geacht de draagconstructie van het gebouw gedurende ten minste 120 minuten te beschermen.

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2 BESCHRIJVING VAN HET OBJECT

2.1 ALGEMEEN

Het betreft een nieuw te bouwen vestiging van een biofarmaceutisch bedrijf. De indeling en het gebruik zijn globaal als volgt:

Kelder:

- Technische ruimten, proceswaterreservoir en sprinklerreservoir

Begane grond:

- Entree met ca. 19 m hoog atrium, receptie, kantoren, was-en kleedruimten
- Technische ruimten, waterbehandeling
- Sprinklerpompruimte
- Gekoeld magazijn (2-8 °C), opslag in palletstellingen, ruimtehoogte ca. 7 m
- Expeditie
- Afvalruimten
- Cleanrooms/laboratoria met zuurkasten
- Paternosterkasten (Kardex).

Mezzanine:

- Enkele technische ruimten (back-up data centre, UPS, waterbehandeling)
- Instellar-ruimte (bekabeling en kanalen luchtbehandeling t.b.v. cleanrooms).

1^e etage:

- Technische ruimten
- Inlaat ventilatieplenum
- Kantoren
- Laboratoria.

Dakopbouwen:

- Uitloop liften en liftmachinekamers
- Trappenhuizen.

In de buitenlucht worden een stikstoftank en een CO₂-tank opgesteld, alsmede de noodstroomvoorziening in containers.

Deze containers worden voorzien van een autonome watermistbeveiliging. De watermistbeveiliging behoort niet tot de scope van dit PvE.

In de laboratoria bevinden zich zuurkasten en kunnen kleine hoeveelheden gevaarlijke stoffen aanwezig zijn (zie de voorwaarden in paragraaf 6.1). Opslag van gevaarlijke stoffen vindt plaats in FM approved veiligheidskasten.

2.2 BOUWAARD

Hoofddraagconstructie	: Deels beton, deels staal
Vloeren/tussenvloeren	: Beton, mezzanine boven cleanrooms beloopbaar verlaagd plafond
Dak	: Beton
Dakhelling	: Nagenoeg vlak
Gevels	: Metalen sandwichpanelen op betonplint, kantoren beton/metselwerk
Gevelisolatie	: Minerale wol of PIR (FM-approved)
Dakisolatie	: Minerale wol of PIR (FM-approved).

2.3 **BRANDCOMPARTIMENTSKLASSE**

De WBDBO tussen de gesprinklerde en ongesprinklerde ruimten bedraagt ten minste 60 minuten.

Er is sprake van brandcompartimentsklasse B in de zin van Technisch Bulletin 65.

3 **VOORSCHRIFTEN/ BEOORDELING RISICO**

Het risico is beoordeeld op basis van de betreffende FM data sheets.

Onderstaande voorschriften zijn van toepassing:

- FM 1-12, July 2020 v.w.b. de beveiliging van loze ruimten boven verlaagde plafonds.
- FM 1-56, April 2020 v.w.b. de cleanrooms
- FM 2-0, October 2020 v.w.b. de algemene uitvoeringseisen.
- FM 2-81, October 2020 v.w.b. beheer en onderhoud.
- FM 3-2, October 2015 v.w.b. het sprinklerreservoir.
- FM 3-7, April 2012 v.w.b. de sprinklerpompen.
- FM 3-26, Januari 2021 v.w.b. de prestatie-eisen in de kantoren e.d.
- FM 8-1, April 2020 v.w.b. classificatie van goederen
- FM 8-9, October 2020 v.w.b. de prestatie-eisen en toegestane opslagconfiguraties in de gebieden met opslag van goederen.
- FM 8-34, October 2020 v.w.b. de paternosterkasten (Kardex)
- NEN-EN 12845:2015+NEN 1073:2018 nl, hier verder aangeduid met NEN 12845, inclusief de tot op heden verschenen Technische Bulletins v.w.b.:
 - Bouwkundige eisen m.b.t. ongesprinklerd ruimten/scheidingen
 - Materialen van leidingen en bevestigingen
 - Meldingen en signaleringen
 - Elektrische voeding van de elektrisch aangedreven sprinklerpomp.

Alle specifieke sprinklermaterialen moeten FM-approved zijn.

4 SPRINKLERINSTALLATIE

4.1 OMVANG

Het complex moet geheel zijn gesprinklerd, uitgezonderd:

- De veiligheidskasten voor opslag van gevaarlijke stoffen
- Hoog-, midden- en laagspanningsruimten
- Toilet- en doucheruimten (voorruimten wel gesprinklerd)
- Loze ruimten boven verlaagde plafonds, mits wordt voldaan aan FM 1-12
- Liftschachten en elektrische liftmachinekamers
- Vriescellen
- Luifels/gebouwoverstekken
- De containers met noodstroomvoorziening (autonome watermistinstallatie).

Niet betreedbare zuurkasten en het bijbehorende afzuigsysteem behoeven conform technisch bulletin 72 niet te zijn gesprinklerd indien:

- Er niet gewerkt wordt met vloeistoffen met een vlampunt $< 60\text{ }^{\circ}\text{C}$, of indien wel gewerkt wordt met vloeistoffen met een vlampunt $< 60\text{ }^{\circ}\text{C}$:
- De zuurkasten en het ventilatiesysteem een brandklasse A of B bezitten volgens NEN 13501-1 of gelijkwaardig.

Het totaal te sprinkleren vloeroppervlak bedraagt ca 18.000 m².

4.2 WATERVOORZIENING EN HYDRAULISCHE BEREKENINGEN

De watervoorziening moet bestaan uit twee pompen, elk met de volledige capaciteit, die hun water betrekken uit een gemeenschappelijke betonnen reservoir. Aangezien er sprake is van negatieve zuighoogte moeten “vertical shaft” pompen worden toegepast.

De pompen moeten als volgt worden aangedreven:

- Eén door een dieselmotor en één door een elektromotor, of
- Beide door dieselmotoren.

Voor de uitvoering van de elektrische installatie ten behoeve van de eventuele elektromotor wordt verwezen naar hoofdstuk 10.8 van NEN 12845 en Technisch Bulletin 74b.

De vereiste watervoorraad bedraagt naar verwachting ca. 600 m³. De exacte vereiste hoeveelheid moet door de installateur op basis van hydraulische berekeningen worden bepaald.

Het reservoir moet zijn voorzien van een automatische suppletie t.b.v. het compenseren van normale gebruiksverliezen. Een capaciteit van 75 l/min wordt hiertoe voldoende geacht.

In geval van een calamiteit moet het reservoir binnen 8 uur handmatig geheel kunnen worden gevuld met leidingwater.

In de hydraulische berekeningen hoeft geen rekening te worden gehouden met een gelijktijdige afname via hydranten en/of brandslanghaspels. Deze zijn/worden op de drinkwaterleiding aangesloten.

4.3 ONTWERPGEGEVENS

Kantoren, kantine, was-en kleedruimten e.d Loze ruimten boven verlaagde plafonds (indien gesprinklerd) Laboratoria, uitgezonderd cleanrooms	
Hoogte	: Niet meer dan 9 m
Gevarenklasse	: HC1
Type installatie	: Nat
Min. sproeidichtheid	: 4 mm/min
Max. sproeivlak	: 140 m ²
Min. sproeitijd	: 120 min (eis opdrachtgever)
Sprinklers	: Non storage, quick response
K-factor	: Ten minste 80
Aanspreektemperatuur	: Ca. 74 °C

Dataruimten	
Hoogte	: Ca. 2,5 - 3 m
Gevarenklasse	: HC1
Type installatie	: Single-interlocked preaction
Min. sproeidichtheid	: 4 mm/min
Max. sproeivlak	: 140 m ²
Min. sproeitijd	: 120 min (eis opdrachtgever)
Sprinklers	: Non storage, quick response, upright of dry-pendent
K-factor	: Ten minste 80
Aanspreektemperatuur	: Ca. 74 °C
Opmerking:	
Aansturing d.m.v. brandmeldinstallatie, zie desbetreffende PvE.	

Atrium (hoogte ca. 19 m)	
Gevarenklasse	: HC1
Type installatie	: Nat
Min. sproeidichtheid	: 24 mm/min
Max. sproeivlak	: 110 m ²
Min. sproeitijd	: 120 min (eis opdrachtgever)
Sprinklers	: Non storage, quick response
K-factor	: Ten minste 80
Aanspreektemperatuur	: Ca. 74 °C

Technische ruimten Sprinklerpompruimte HVAC-ruimten Instellar-ruimte	
Gevarenklasse	: HC2
Type installatie	: Nat
Min. sproeidichtheid	: 8 mm/min
Max. sproeivlak	: 230 m ²
Min. sproeitijd	: 120 min (eis opdrachtgever)
Sprinklers	: Non storage, quick response
K-factor	: Ten minste 80
Aanspreektemperatuur	: Ca. 100 °C

Cleanrooms	
Gevarenklasse	: HC2
Type installatie	: Nat
Min. sproeidichtheid	: 8 mm/min
Max. sproeivlak	: 280 m ²
Min. sproeitijd	: 120 min (eis opdrachtgever)
Sprinklers	: Non storage, standard coverage, quick response, pendent
K-factor	: Ten minste 80
Aanspreektemperatuur	: Ca. 74 °C
Opmerking:	
Desgewenst mogen concealed sprinkler worden toegepast. Toepassing van <u>sealed</u> concealed sprinklers is niet toegestaan.	

Gekoeld magazijn (2-8 °C)	
Opslag	: Maximaal uncartoned unexpanded plastics in palletstellingen
Hoogte	: Ca. 7 m
Bron	: FM 8-9, table 10
Type installatie	: Nat (zie opmerking)
Min. sproeitijd	: 120 min (eis opdrachtgever)
Sprinklers	: Storage , quick response, pendent
K-factor	: 200, 240, 320 of 360
Min. druk	: Resp. 3,5, 2,4, 1,7 of 1,4 bar
Max. sproeivlak	: 10 sprinklers
Aanspreektemperatuur	: Ca. 74 °C
Opmerking:	
Op plaatsen waar de temperatuur lager kan zijn dan 4 °C moet het leidingnet worden voorzien van elektrische tracing en thermische isolatie.	

Expeditie	
Opslag	: Maximaal uncartoned unexpanded plastics in bulk/palletized
Hoogte	: Ca. 7 m
Bron	: FM 8-9, table 5
Type installatie	: Nat
Min. sproeitijd	: 120 min (eis opdrachtgever)
Sprinklers	: Storage, Quick response, pendent
K-factor	: 200, 240 of 320
Min. druk	: Resp. 3,5, 2,4 of 1,4 bar
Max. sproeivlak	: 9 sprinklers
Aanspreektemperatuur	: Ca. 74 °C

Paternosterkasten (met gesloten bovenzijde)	
Opslag	: Plastics
Hoogte	: Ca. 6 m (inwendig)
Bron	: FM 8-34, section 2.4
Type installatie	: Nat
Min. sproeitijd	: 120 min (eis opdrachtgever)
Sprinklers	: Storage
K-factor	: Ten minste 160
Min. opbrengst	: 115 l/min
Max. sproeivlak	: Alle sprinklers in één paternosterkast
Aanspreektemperatuur	: Ca. 74 °C
Onderlinge afstand	: Maximaal 2,4 m

Boven elk loadingdock moet een droge horizontale sprinkler door de gevel worden aangebracht.

4.4 ALARMKLEPPEN/SPRINKLERZONERING

Er kan worden volstaan met één natte alarmklep.

Elke bouwlaag moet afzonderlijk d.m.v. een stromingsschakelaar als aparte zone worden gesignaleerd.

De sprinklers in de dakopbouwen behoeven niet apart te worden gesignaleerd. Deze mogen worden aangesloten op de zone van de 1^e etage.

De preaction alarmkleppen mogen zijn uitgevoerd als staartklep (aangesloten achter de natte alarmklep).

5 SPRINKLERMELDINSTALLATIE

5.1 ALGEMEEN

Er wordt een autonome sprinklermeldcentrale toegepast. Deze centrale wordt in de sprinklerpompruimte opgesteld. T.b.v. de brandmeld- en ontruimingsalarminstallatie en watermistbeveiliging worden eveneens autonome centrales toegepast.

5.2 SIGNALERINGEN

Onderstaande meldingen moeten worden signaleerd:

Brandmeldingen:

- Algemeen brandalarm
- Brandalarm natte alarmklep
- Brandalarm per preaction-klep
- Brandalarm per stromingsschakelaar.

Storingsmeldingen:

- Laag/hoog niveau waterreservoir
- Lage temperatuur pompruimte
- Lage druk hoofdleiding
- Storing jockeypomp
- Lage druk preaction systeem
- Storing persluchtvoorziening preaction systeem
- Algemene storing diesel gedreven sprinklerpomp
- Storing elektrische voeding
- Pomp in bedrijf
- Stuurfunctie(s) overbrugd.

Supervisiemeldingen:

Alle relevante afsluiters moeten elektrisch op de juiste stand worden bewaakt.

5.3 STUURFUNCTIES

Bij het in werking treden van de sprinklerinstallatie moeten onderstaande stuurfuncties worden verricht:

- Activeren ontruimingsalarminstallatie
- Aansturing brandweer-/nevenpaneel
- Aansturen flitslicht bij brandweeringang
- Vrijgeven toegang tot terrein/sleutelkuis
- Vrijgeven toegangscontrolesysteem/elektrisch vergrendelde vluchtdeuren
- Sluiten van niet-zelfsluitende brandwerende deuren
- Afschakelen ventilatie indien van toepassing (zie 6.3)
- Aansturen liften (naar begane grond, met open deuren parkeren)
- Externe doormelding brandalarm.

5.4 BRANDWEERINGANG

Bij de brandweeringang moeten onderstaande voorzieningen aanwezig zijn:

- Rood flitslicht
- Een geografisch brandweerpaneel.

N.B. Toepassing van een sleutelbuis of -kuis is niet vereist aangezien het bedrijf 24/7 geopend is.

5.5 NEVENPANEEL

Bij de receptie moet een nevenpaneel worden aangebracht.

5.6 EXTERNE DOORMELDING

Brandalarmen van de sprinklerinstallatie moeten worden doorgemeld naar de regionale alarmcentrale (RAC) of naar een erkende Particuliere Alarmcentrale (PAC).

Storingsalarmen van de sprinklerinstallatie moeten worden doorgemeld naar een erkende Particuliere Alarmcentrale (PAC).

De transmissie moet voldoen aan type 1 of 2 conform NEN-EN 54-21.

6 BOUWKUNDIGE EN TECHNISCHE VOORZIENINGEN

6.1 ONGESPRINKLERDE RUIMTEN

Onderstaande ruimten/delen behoeven niet te zijn gesprinklerd indien de WBDBO ten opzichte van de gesprinklerde ruimten ten minste 60 min bedraagt:

- Hoog-, midden- en laagspanningsruimten
- Liftschachten en elektrische liftmachinekamers
- ~~Vriescellen~~
- Containers met daarin de noodstroomvoorziening.

Douche- en toiletruimten behoeven niet te zijn gesprinklerd indien:

- De wanden en plafonds uit onbrandbare materialen bestaan
- Er in de ruimte geen opslag van goederen plaatsvindt.

N.B. Voorruimten moeten wel zijn gesprinklerd.

Luifels/gebouwoverstekken behoeven niet te worden gesprinklerd indien:

- Deze geheel uit onbrandbare materialen bestaat of brandwerend is afgescheiden van het gesprinklerde gebied, en
- Er onder de luifel/overstek geen opslag van brandbare goederen plaatsvindt.

Verborgene ruimten boven verlaagde plafonds behoeven niet te zijn gesprinklerd indien aan de betreffende eisen volgens FM1-12 wordt voldaan.

6.2 SPRINKLERPOMPRIJNTE

De brandwerendheid tussen de sprinklerpompruimte en de aangrenzende gesprinklerde ruimten moet ten minste 60 minuten bedragen (E en I-criterium). De ligging en toegankelijkheid behoeven de instemming van het bevoegd gezag.

6.3 VENTILATIE

Op plaatsen waar de lichtsnelheid ter plaatse van de sprinklers meer dan 1,52 m/s kan bedragen moet de ventilatie bij brandalarm worden afgeschakeld.

7 BEPALINGEN M.B.T. OPSLAG VAN GOEDEREN

Op het terrein mag geen opslag van brandbare goederen plaatsvinden binnen een afstand tot het gesprinklerde complex van 10 m en 1,5 x de hoogte van de opslag, tenzij de gevel ter plaatse een brandwerendheid bezit van ten minste 60 min of is voorzien van een gevelbeveiliging.

N.B. Geparkeerde personenauto's worden niet aangemerkt als "opslag van brandbare goederen" en mogen binnen 10 m vanaf het gebouw worden geparkeerd.

Tussen het niveau van de sprinklers aan het dak en de bovenzijde van opgeslagen goederen/inventaris moet een vrije ruimte van ten minste 914 mm aanwezig zijn.

In het gekoelde magazijn, de expeditie en opslagruimten is onderstaande opslag toegestaan tot 914 mm onder het niveau van de sprinklers:

- Class 1 t/m 4
- Ongeschuimde kunststoffen
- Schuimkunststof mits in kartonnen dozen.
- Bovenstaande goederen op houten en/of kunststof pallets.

Brandbare bakken/containers/kisten waarin zich bluswater kan verzamelen mogen niet in stellingen worden opgeslagen. Dergelijke bakken/containers/kisten moeten zijn voorzien van openingen in of direct boven de bodem of van een gesloten deksel of uitsluitend op het onderste niveau in de stellingen worden geplaatst.

Stellingen mogen niet zijn voorzien van dichte legborden in de zin van FM 8-9 (zie bijlage 2 definitie "Open-Frame Rack Storage").

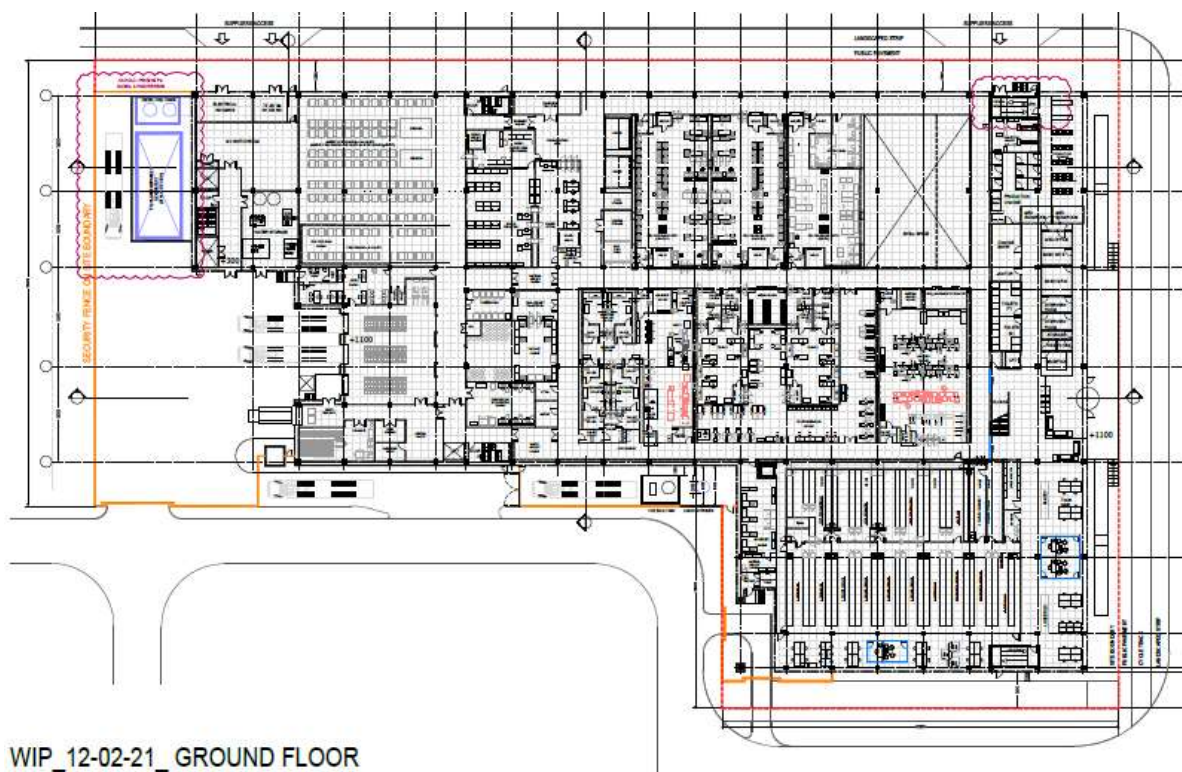
In stellingen moeten trekkanalen ("Fue Spaces") aanwezig zijn conform FM 8-9 (zie bijlage 2).

8 OVERZICHT AKKOORDVERKLARINGEN

Bristol-Myers Squibb Company:

Bevoegd gezag:

Bijlage 1:
Situatie



Bijlage 2

2.2.3 Flue Spaces

Flue spaces within storage configurations that are arranged as outlined in this data sheet will promptly vent heat from a fire vertically. This allows for (1) the sprinklers to operate as quickly as possible, and (2) reduced horizontal fire spread within the storage array. Flue spaces arranged as outlined in this data sheet will also allow sprinkler water penetration down through the storage arrangement. Without sufficient water penetration to burning commodities throughout the storage array, fire control may not be achieved.

2.2.3.1 Flue Spaces for Rack Storage Protected by Ceiling-Level Sprinklers Only

2.2.3.1.1 In single-row racks, maintain all transverse flue spaces at a minimum net width of 3 in. (75 mm) throughout the vertical height of the rack. Provide transverse flue spaces a maximum of every 4-1/2 ft (1.4 m) horizontally when their net width is less than 6 in. (150 mm) or when their vertical alignment cannot be maintained. The maximum horizontal distance between well-maintained, vertically aligned transverse flue spaces can be increased to 9 ft (2.7 m) when their net width is 6 in. (150 mm) or greater.

2.2.3.1.2 In double-row racks, maintain all transverse flue spaces at a minimum net width of 3 in. (75 mm) throughout the vertical height of the rack. Provide transverse flue spaces a maximum of every 4-1/2 ft (1.4 m) horizontally when their net width is less than 6 in. (150 mm) or when their vertical alignment cannot be maintained. The maximum horizontal distance between well-maintained, vertically aligned transverse flue spaces can be increased to 9 ft (2.7 m) when their net width is 6 in. (150 mm) or greater and a minimum 6 in. (150 mm) wide vertically aligned longitudinal flue space is provided.

2.2.3.1.3 Longitudinal flue spaces are not required in double-row racks; however, if they are provided, maintain a minimum net width of 3 in. (75 mm) throughout the vertical height of the rack.

2.2.3.1.4 In multiple-row racks, maintain minimum 6 in. (150 mm) wide vertically aligned flue spaces a maximum of every 5 ft (1.5 m) throughout the height of the rack.

2.2.3.1.5 For multiple-row racks not in accordance with Section 2.2.3.1.4:

- a) Provide minimum 6 in. (150 mm) wide transverse flue spaces a maximum of every 5 ft (1.5 m) horizontally, and
- b) Limit the depth of the multiple-row rack to 20 ft (6.0 m)

Open-Frame Rack Storage: Rack storage that is void of any solid shelves within the storage array and has adequate flue spaces to (1) allow rapid vertical fire growth (minimizing horizontal fire spread), and (2) allow downward sprinkler water penetration throughout the height of the rack. Open-frame rack storage allows water discharge to reach all vertical surfaces of a commodity.

For rack storage to qualify as open-framed it must:

- Have adequate transverse flue spaces throughout the height of the rack at maximum of every 9 ft (2.7 m) horizontally, and
- Be void of blocked transverse flue spaces.

Open-frame racks can be equipped with solid shelves provided that

- The solid shelves are fixed-in-place, and
- Are no larger than 20 ft² (2.0 m²) in area, and
- Do not block transverse flue spaces.

Multiple-row racks with butted storage can be treated as open-frame racks under the following conditions:

- The racks are void of solid shelves, and
- They have pallet loads butted in one direction, and
- Pallet loads are no wider than 5 ft (1.5 m), and
- Minimum 3 in. (75 mm) net clear width transverse flue spaces on each side of each butted row are provided, and
- A minimum net 6 in. (150 mm) wide longitudinal flue space is provided a maximum of every 16 ft (4.8 m) horizontally.

The storage racks can also be provided with grated shelves as long as the grating is at least 70% uniformly open, or they can be provided with fixed-in-place solid slats as long as adequate transverse flue spaces are provided between all pallet loads.

Theo Selten | moBius consult

Van: Wilschut, Maarten-Jan <Maarten-Jan.Wilschut@fmglobal.com>
Verzonden: maandag 7 juni 2021 10:31
Aan: Theo Selten | moBius consult; Huub VAN DEN HENGEL
Onderwerp: RE: Aanpassing UPD sprinkler project triton

Hallo Theo,

Lijkt mij prima voor FM.

Ik schrijf er verder geen aparte officiële Plan Review Letter voor.

Kind regards / Met vriendelijke groet,

MAARTEN-JAN WILSCHUT | Engineering Specialist

Frankfurt Operations - Amsterdam office - Netherlands

FM Global | FM Insurance Europe S.A. | Cross Towers - Antonio Vivaldistraat 150 | 1083 HP Amsterdam – Netherlands

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From: Theo Selten | moBius consult <T.Selten@mobiusconsult.nl>

Sent: donderdag 3 juni 2021 09:54

To: Huub VAN DEN HENGEL <huub.van-den-hengel@bureauveritas.com>; Wilschut, Maarten-Jan <Maarten-Jan.Wilschut@fmglobal.com>

Subject: FW: Aanpassing UPD sprinkler project triton

Importance: High

EXTERNAL EMAIL

Hallo Huub en Maarte-Jan,

Verzoek om dit document te verifiëren vanwege enkel kleine wijzigingen

Met een vriendelijke groet, regards,

Theo Selten

Senior adviseur brandveiligheid

Werkdagen ma, di, wo, do.

Verlof/leave 17-07 til 01-08

moBius consult bv

Driebergen - Delft

onderzoeks en adviesbureau op het gebied

van bouwfysica, akoestiek, brandveiligheid,

duurzaam bouwen en installatietechniek

KvK Utrecht 30105943



INSPECTIERAPPORT BASISONTWERP

Kenmerk: BSO-4082790 -DSP-01-21

Datum rapport: 9 juni 2021

Objectgegevens
Bristol-Meyers Squibb Company
Willem Enthovenstraat
Oegstgeest

Algemene gegevens:

Datum onderzoek	: 9 juni 2021				
Inspecteur	: Huub van den Hengel				
Inspectieplan	: Kenmerk IPLP-4082790-DSP-01-21				
Inspectieschema	: CCV-Inspectieschema brandbeveiliging - Inspectie basisontwerp brandbeveiligingssysteem (VBB-BMI-OAI-RBI) op basis van afgeleide doelstellingen, versie 9.0				
Basisontwerp	<div>: Kenmerk: PvE BMS Oegstgeest versie 8 / 9 juni 2021 / SprinklerAdvies</div> <div>Voorschriften die bepalend zijn voor het normatief kader: FM 1-12, July 2020 v.w.b. de beveiliging van loze ruimten boven verlaagde plafonds.<ul style="list-style-type: none">• FM 1-56, April 2020 v.w.b. de cleanrooms• FM 2-0, October 2020 v.w.b. de algemene uitvoeringseisen.• FM 2-81, October 2020 v.w.b. beheer en onderhoud.• FM 3-2, October 2015 v.w.b. het sprinklerreservoir.• FM 3-7, April 2012 v.w.b. de sprinklerpompen.• FM 3-26, Januari 2021 v.w.b. de prestatie-eisen in de kantoren e.d.• FM 8-1, April 2020 v.w.b. classificatie van goederen• FM 8-9, October 2020 v.w.b. de prestatie-eisen en toegestane opslagconfiguraties in de gebieden met opslag van goederen.• FM 8-34, October 2020 v.w.b. de paternosterkasten (Kardex)• NEN-EN 12845:2015+NEN 1073:2018 nl, inclusief de tot op heden verschenen Technische Bulletins v.w.b.:<ul style="list-style-type: none">o Bouwkundige eisen m.b.t. ongesprinklerd ruimten/scheidingeno Materialen van leidingen en bevestigingeno Meldingen en signaleringeno Elektrische voeding van de elektrisch aangedreven sprinklerpomp.</div>				
Beoogde afgeleide doelstelling(en)	<table><tr><th>Systeem</th><th>Afgeleide doelstelling</th></tr><tr><td>Sprinklersysteem</td><td>Een beginnende brand in een vroeg stadium detecteren, signaleren en onder controle houden zodat het bestrijden ervan door de interne en externe brandbestrijdingsorganisaties kan plaatsvinden waardoor schade wordt beperkt, binnen de context van het basisontwerp.</td></tr></table>	Systeem	Afgeleide doelstelling	Sprinklersysteem	Een beginnende brand in een vroeg stadium detecteren, signaleren en onder controle houden zodat het bestrijden ervan door de interne en externe brandbestrijdingsorganisaties kan plaatsvinden waardoor schade wordt beperkt, binnen de context van het basisontwerp.
Systeem	Afgeleide doelstelling				
Sprinklersysteem	Een beginnende brand in een vroeg stadium detecteren, signaleren en onder controle houden zodat het bestrijden ervan door de interne en externe brandbestrijdingsorganisaties kan plaatsvinden waardoor schade wordt beperkt, binnen de context van het basisontwerp.				
Demarcatie inspectie	: Het gehele basisontwerp is geïnspecteerd.				

Conclusie:



Bureau Veritas is aangesloten bij de VIVB Branchevereniging voor brandveiligheidsinspecties

Dit rapport mag alleen in zijn geheel aan derden ter beschikking worden gesteld.
De geldigheid van de accreditatie kan nagegaan worden bij www.rva.nl.



Kan met het basisontwerp worden voldaan aan de afgeleide doelstelling(en) die met het brandbeveiligingssysteem wordt (worden) beoogd?	Ja
---	-----------

Bureau Veritas Industrial Services		
Plaats	: Amersfoort	Dit document is digitaal geautoriseerd door W.F. Koning

1 INLEIDING

In Europese en Nederlandse wet- en regelgeving zijn op brandveiligheidsgebied in algemene zin de volgende primaire doelstellingen te onderscheiden:

- veilig vluchten;
- schadebeperking.

Om aan de primaire doelstelling te kunnen voldoen zijn vaak één of meerdere brandbeveiligingssysteemen noodzakelijk, die elk hun eigen functie hebben. Deze functie is uitgedrukt in afgeleide doelstellingen. Deze afgeleide doelstellingen ondersteunen de primaire doelstellingen.

Deze inspectie van het basisonwerp betreft elk op het voorblad van dit rapport genoemd brandbeveiligingssysteem c.q. installatie met bijbehorende afgeleide doelstelling(en).

Het doel van de inspectie is om vast te stellen of het basisonwerp beantwoordt aan elke afgeleide doelstelling die met de brandbeveiliging wordt beoogd en of dit kan leiden tot een inspectiecertificaat.

Een beveiligingssysteem op basis van een brandbeveiligingsinstallatie voldoet aan de afgeleide doelstelling(en) als de verwachte prestatie van de installatie is afgestemd op het gebruik van het object en de bouwkundige en organisatorische randvoorwaarden.

In dat kader wordt het basisonwerp beoordeeld op basis van:

- criteria met betrekking tot volledigheid, zoals opgenomen in § 7.1 van het CCV-document 'CCV Inspectieschema Brandbeveiliging – Inspectie basisonwerp brandbeveiligingssysteem (VBB-BMI-OAI-RBI) op basis van afgeleide doelstellingen' als op voorblad vermeld
- inspectiepunten. Deze zijn opgenomen in § 7.3 van het CCV-document 'CCV Inspectieschema Brandbeveiliging – Inspectie basisonwerp brandbeveiligingssysteem (VBB-BMI-OAI-RBI) op basis van afgeleide doelstellingen' als op voorblad vermeld.

In onderstaand(e) hoofdstuk(ken) zijn de bevindingen van de inspectie vastgelegd, om de herleidbaarheid van de conclusie van dit inspectierapport mogelijk te maken.

2 INSPECTIE BASISONTWERP SPRINKLERSYSTEEM

Tabel 2.1 Afwijkingen:
Resultaten op basis van de inspectiepunten van het sprinklersysteem die leiden tot afkeur

Referentie uit basisonwerp:	Afwijking:
PvE	1. Geen.

Tabel 2.2 Aandachtspunten:
Resultaten op basis van de inspectiepunten van het sprinklersysteem, die de grens van het normatief kader benaderen, maar niet hebben geleid tot afkeur

Referentie uit basisonwerp:	Aandachtspunt:
PvE	1. Geen.

Tabel 2.3 Vaststellingen:
Bevindingen over de inspectie van het sprinklersysteem, die geen invloed hebben op de afgeleide doelstelling

Referentie uit basisonwerp:	Vaststelling:
§ 1	1. De hiergenoemde documenten maken geen deel uit van deze validatie: <ul style="list-style-type: none">– Project Report Index-Rec No: NE6220.00-04 van FM Global– Indelingstekeningen WIP_12-02-21– Toetsing brandveiligheid Bouwbesluit van moBius consult.
§ 4.3	2. Het PvE, waarin de aansturing van de pre-action klep(pen) in de data-ruimte(n) is omschreven, is niet in ons bezit en maakt geen deel uit van deze validatie.

Tabel 2.3 Vaststellingen: Bevindingen over de inspectie van het sprinklersysteem, die geen invloed hebben op de afgeleide doelstelling	
Referentie uit basisontwerp:	Vaststelling:
§ 5.3 en § 5.4	3. Bij de sturingen staat vermeld “vrijgeven toegang tot terrein/sleutelkuis”. Bij de brandweeringang is vermeld dat dit niet is vereist aangezien het bedrijf 24/7 geopend is.

Bijlage

7 Addendum Solar Photovoltaic Panels on Project Letter dated 8 februari 2021

PROJECT REPORT



Mr. Eddie Bolger (DPS)
Bristol-Myers Squibb Company
J.H. Oortweg 19 – Leiden Bio Science Park
2333 CH Leiden, Zuid Holland
The Netherlands

Index-Rec No: NE6220.00-04
Account No: 01-31058
Date of Report: 17-MAR-2021

Conference with: Representatives from Bristol-Myers Squibb Company, DPS and Mobius Consult.

Project Name: EU CTF Project: Addendum Solar Photovoltaic Panels on Project Letter dated 8-FEB-2021.

Executive Summary:

This addendum is written since it is the intention to install solar photovoltaic (PV) panels as part of the project. Please refer to the projectletter of 8-FEB-2021 for all other project information and recommendations.

With this project letter FM Global would like to highlight the following recommendations:

- Install an FM Approved roof with an external fire rating of Class "A".
- Adhere to the recommendations on the various roof loads and do not take any reduction factors into account.

This report has been developed for insurance underwriting purposes. It is provided to you for informational purposes only to reduce the possibility of loss to insured property by bringing to your attention certain potential hazards or conditions. Life, safety, or health issues are not addressed. You must make the decision whether to take any action. The company undertakes no duty to you or any other party by providing this report or the activities on which it is based. The liability of the company is limited to that contained in its insurance policies.

Loss Prevention Recommendations:

Location, Construction and Occupancy

FM Global Property Loss Prevention Data Sheets are referred to as *FM Data Sheets* or *Data Sheets*. A list of referenced data sheets is added below the recommendations. All data sheets are available free of charge via www.fmglobal.com.

#	Recommendation
	Installation of Solar Photovoltaic Roof Panels
	In the next paragraphs the most important items related to installation of photovoltaic panels (PV-panels) in the Netherlands are highlighted. All detailed recommendations can be found in FM Global Property Loss Prevention Data Sheet 1-15, <i>Roof Mounted Solar Photovoltaic Panels</i> .
	<p>External Fire Hazard: <i>Exterior fire exposure due to the ignition of combustible components of the roof assembly below the PV panels (or from adjacent buildings, yard storage, wildland fires and bushfires) can damage PV panels.</i></p> <p><i>The lower the classification (ASTM E108) of the exterior fire exposure of the roof assembly (cover and insulation, C or B vs. A), the greater tendency there is for fire spread. If above-deck roof components have low melting temperatures, they can burn and flow. If there is a lack of protection at roof expansion joints, an exterior roof fire could spread into the building and cause extensive interior damage.</i></p> <p><i>This could lead to significant fire-, smoke- and water damage to the roof as well as to the products stored or occupancy inside the building, leading to significant property damage and business interruption.</i></p>
1.31	It is preferred to install PV panels over a noncombustible roof assembly. Fires caused by PV panels on roofs containing combustible material may lead to higher loss amounts and could lead to longer downtime of the operation. This also applies to roofs that contain FM Approved materials.
1.32	PV panels should not be installed on thermoplastic insulation (Expanded Polystyrene (EPS) or Extruded Polystyrene (XPS)) or multi ply roof cover (e.g. multi-ply bitumen or EPDM).
1.33	Do not use PV-panels that contain foam plastic.
1.34	Roof mounting frames should be noncombustible.
1.35	Provide sufficient aisle spaces of 1.2 m between other PV arrays, other adjacent rooftop equipment or penetrations. This includes roof lights and skylights. Minimum 1.2 m wide aisles at a maximum of 46 m in each direction is recommended.
1.36	Arrange pre-fire planning with the fire service. Ensure they are familiar with ground access, stairs to the roof, PV array aisles, the location of combiner boxes and inverters, and all related fuses and disconnects.
	<p>Collapse Hazard Gravity loads and roof drainage <i>Excessive loads from snow and rainwater accumulations on a roof in conjunction with the weight of these PV systems can damage or collapse a roof, particularly where the PV systems impede rainwater flow to drains.</i></p> <p><i>PV panels with greater slopes and heights will increase snow accumulations and potential collapse unless the roof can support the extra load.</i></p> <p><i>Overloading could lead to partial or full collapse of the roof damaging the building as well as the products stored or occupancy inside the building, leading to significant property damage and business interruption.</i></p>
1.37	<p>The additional load posed on the roof by the installed PV panels and possible ballast should be verified using Eurocode and Dutch National Annexes with the following design loads (already stated in recommendation 1.6.)</p> <p>➤ Design for a Consequence Class CC2. (1)*</p>

This report has been developed for insurance underwriting purposes. It is provided to you for informational purposes only to reduce the possibility of loss to insured property by bringing to your attention certain potential hazards or conditions. Life, safety, or health issues are not addressed. You must make the decision whether to take any action. The company undertakes no duty to you or any other party by providing this report or the activities on which it is based. The liability of the company is limited to that contained in its insurance policies.

#	Recommendation
	<ul style="list-style-type: none"> ➤ Design for a Design Working Life of 50 years. (2)* ➤ Use a roof snow load equal to the ground snow load. The 50-year ground snow load for the Netherlands is 0.7 kN/m². (3)* ➤ Consider Snow drift loads per Eurocode 1 Part 3 and its Dutch National Annex or FM Global Data Sheet 1-54. <p>(1-3)* See appendix for important footnotes related to this calculation.</p>
1.38	The PV panels should not block any rain drainage systems.
1.39	Specific details related to the design can be found in FM Global Property Loss Prevention Data Sheet 1-15, <i>Roof Mounted Solar Photovoltaic Panels</i> and 1-54, <i>Roof Loads for New Construction</i> , section 2.9.
	<p>Wind Exposure Hazard:</p> <p><i>Inadequate windstorm resistance can result in varying degrees of damage to roof-mounted PV solar panels. In a worst-case scenario, they could be dislodged, break, and become windborne debris that damages other panels and roof covers, allowing water to enter the building causing damage to interior and contents.</i></p> <p><i>This could not only lead to property damage to the roof and panels, especially rainwater entering the building through the damaged roof cover could damage the products stored or occupancy inside the building, leading to significant property damage and business interruption.</i></p>
1.40	<p>Install ballasted (4)*, rigid PV roof-mounted solar panels only over fully adhered roof covers. When a ballasted PV array is proposed over an existing mechanically fastened single-ply roof cover that is relatively new, do one of the following:</p> <ul style="list-style-type: none"> A. Locate the array with a minimum setback distance equal to twice the roof height and fasten each module around each outside edge of each array. B. Mechanically fasten PV panels throughout the entire array, such as by fastening each module around each outside edge of each array, and then intermittently fasten the remaining PV modules in the interior of the array at every second module in their long dimension and every third module in their short dimension. <p>(4)* See appendix for important footnotes related to this calculation.</p>
1.41	Anchor all related equipment such as combiner/junction boxes and conduits to the roof deck or roof structural members as required to provide proper anchorage against expected loads. Use mechanical anchors that can be connected to the equipment and the roof deck or roof framing. A minimum safety factor of 2.0 should be used for wind loads on panel anchors.
1.42	The wind design of the roof deck and above-deck components should be designed to resist the wind uplift pressures for NEN-EN-1991-1-1-4, 50yr MRI and CC2.
	<p>Electrical Installation & Maintenance Hazard:</p> <p><i>Fires of electrical origin are common in roof-mounted solar arrays. There are enough combustible material present in the form of roof coverings and insulation, which are more likely to become ignited with the PV system there. Also, the redirection of flames and re-radiation of heat by the PV panels from a roof fire tend to create more fire spread than if the panels were not there. Following the electrical guidance in this document will reduce, but not eliminate, the likelihood of a fire. The goal of these recommendations is to resolve the initial problem prior to the second ground fault. Given a second ground fault, this can result in enough energy to start a roof-top fire.</i></p>
1.43	Install new PV electrical energy systems, including the array circuit(s), inverter(s), and controller(s) for these systems, in accordance with the current version of NEN1010, the Dutch implementation of the HD-IEC 60364 series.
1.44	Provide Module Level Power Electronics (such as DC optimizers and microinverters) that sense and isolate faults and deenergize the array at the module level and alarm such faults. The system should

#	Recommendation
	report the alarm condition to remote network monitoring software, enabling rapid shutdown of PV systems on buildings.
1.45	Do not install electrical wiring within the rib opening of steel decking or otherwise within the plane of the above-deck components.
1.46	Ensure adequate provision is made for expansion and contraction due to extreme temperature fluctuations during the year. This includes wiring, as well as the interface between the PV panels and the roof cover.
1.47	Use rigid PV panels that meet electrical performance criteria per NEN-EN-IEC 61215-1
1.48	Use rigid PV panels that comply with criteria for electrical safety per NEN-EN-IEC 61730-2.
1.49	Maintain the PV system in accordance with NEN-EN-IEC 62446-1.
1.50	Check all equipment for damage or required maintenance after severe weather events, including windstorm, lightning, hail, and snowstorms.
1.51	Perform a thermographic survey for all electrical components (e.g. inverters, wire connections and modules) every year.
1.52	Inspect the sealing of roof penetrations for water-tightness annually, and repair or replace as needed.
1.53	Have routine inspection, testing, and maintenance of the PV arrays and related equipment performed by qualified personnel and in accordance with NEN 3140 and the manufacturers' guidelines.
1.54	<p>Information required for submittal to FM Global Plan Review services:</p> <ul style="list-style-type: none"> ➤ Will the existing roof cover remain? If yes, indicate the type of roof cover, type of insulation or cover board immediately below the roof cover, and whether the roof cover is fully adhered to it. Provide a sketch of the roof expansion joint, including the type of insulation within it. ➤ If a new roof cover is proposed, submit complete details for the roof cover, insulation and cover boards, securement methods, and expansion joint description. ➤ Submit the calculation for gravity loads based on the Eurocode. The submittal should verify that the conditions are met from items 2 and 3 and appendix A. ➤ Submit the calculation for basic wind pressure (qh) including the design wind speed, related coefficients or velocity pressure, directionality, topography, etc. ➤ The submittal should verify that the wind pressure coefficients used are based on the effective wind area (EWA) and the location of the modules within the array. The EWA for vertical load distribution for ballasted PV arrays is typically limited to the area of a few modules. Usually the EWA will be the area of 1 to 9 modules depending on the location of the module within the array (corner, edge, or shielded/interior). PV racking that uses rigid framing will have larger EWAs than arrays that have less rigidity
Appendix to the section on Roof Mounted Solar PV Panels	
1.55	<p>(1)* <i>The Dutch Annex to the Eurocode allows designing industrial buildings (with two building levels or less) for a Consequence Class CC1, implying a reduced safety factor for the variable loads of $(0.9 \times 1.5 = 1.35)$ instead of 1.5.</i></p> <p><i>However, it should be noted that this Consequence Class 1 is defined as: "Low consequence for loss of human life, and economic or environmental consequences are small or negligible." In the Eurocode, the examples given for this category are: "agricultural buildings where people do not normally enter". Contrary to the Dutch Annex, Industrial buildings are not given as an example.</i></p> <p><i>In any case, FM Global does not consider loss of a client's facility as an event with small or negligible (economic) consequence and therefore recommends designing for CC2.</i></p>
1.56	<p>(2)* <i>FM Global recommends designing for loads with mean recurrence intervals of 50 years, such as a "once-in-50-years" snow event (or, in other words, a probability of 2% per year). If Eurocodes are used, the building should be designed for a "50 years Design Working Life".</i></p> <p><i>NB: The Eurocode recommends such a 50-year Design Working Life for "Building structures and other common structures" and a 15 to 30 years Design Working Life only for "Agricultural and similar structures".</i></p>

#	Recommendation
	<p><i>The Dutch National Annex to the Eurocode, however, allows designing industrial buildings (with two building levels or less) for a 15 years Design Working Life. The “once-in-15-years” snow load, in example, is 75% of the “once-in-50-years” snow load ($0.7 \times 0.75 \text{ kN/m}^2 = 0.525 \text{ kN/m}^2$).</i></p> <p><i>A mean recurrence interval of 15 years corresponds to a chance of 7% per year. Therefore, the yearly chance of exceeding the design limit is 3.5 times higher for a 15 years Design Working Life than for 50 years one.</i></p>
1.57	<p>(3)* According to the Dutch meteorological institute (KNMI) the 50-year ground snow load for the Netherlands is 0.7 kN/m^2. In regions where the ground snow load is 1.0 kN/m^2 or less, we recommend using a roof snow load not less than the ground snow load. The Eurocode formula for a flat roof, (roof snow load = $0.8 \times$ ground snow load), should not be applied. For the Netherlands, this implies a characteristic roof snow load of 0.7 kN/sq.m.</p>
1.58	<p>(4)* Ballast/wind calculations should be provided for review and should be based on accepted boundary layer wind tunnel test (BLWT) to accept the reduced net pressure coefficients for lift for the different wind zones. In the Netherlands testing has been done by firm Peutz Ltd. The ballast calculations should refer to the wind tunnel test and mention the name of the solar panel company for which the testing have been done.</p>

Managing Hazards during the Project:

Like for any new project, modification, extension or construction of new buildings or equipment, the contractors activities can generate hazards at the construction site. The strict compliance with contractors’ management, hot work management and protection impairment procedures will help to limit those risks.

To properly manage risks during construction:

- Please refer to Data Sheet 1-0, *Safeguards during Construction*.
- Implement the FM Global Hot Work Permit System with a permanent *fire watch* during all hot work activities including breaks. The *fire watch* should remain in place for 60 minutes after the hot work job has ended. Please refer to Data Sheet 10-3, *Hot Work Management*.
- Strictly prohibit smoking on the construction site.
- Organise housekeeping by keeping combustibles inside the building to a minimum and away from ignition sources like electrical equipment and hot work areas.
- Remove combustible wastes as often as possible and practicable from the construction in progress.
- If possible: install and take into service the sprinkler installation before any combustibles are moved into the new building.
- Impairments to the sprinkler and other fire protection systems should be managed using the FM Global Red Tag Permit system.

FM Global References:

Nr.	Title	Nr.	Title
1-0	<i>Safeguards during Construction</i>	1-20	<i>Protection against Exterior Fire Exposure</i>
1-1	<i>Firesafe Building Construction and Materials</i>	1-28	<i>Wind Design</i>
1-12	<i>Ceilings and Concealed Spaces</i>	1-29	<i>Roof Deck Securement and Above-Deck Roof Components</i>
1-15	<i>Roof Mounted Solar Photovoltaic Panels</i>	1-54	<i>Roof Loads for New Construction</i>

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FM Global Loss Prevention Training

Approval Guide

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(FIRE SAFETY REPORT)
TRITON CELL THERAPY FACILITY EU
LEI-310-F-REP-01

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