# EQUIPMENT YARD SPACE CALCULATIONS

## 24 MW Master Plan (2 Data Halls × 12 MW Each)

### Pryor Data Center - PACHYDERM GLOBAL

**Parent Document:** [[Saga Pryor DC/Basis of Design/Erik\_BOD\_Updated/\_BOD - Exec Summary and TOC]]

## EXECUTIVE SUMMARY

| Yard Type | Equipment Count | Footprint (SF) | Service Corridors | Total Area (SF) |
| --- | --- | --- | --- | --- |
| **Electrical Yard** | 6 gens + 8 xfmrs + RMUs + switchgear | 45,000 | 40,000 | **~85,000** |
| **Mechanical Yard** | 12 chillers (Phase 2 max) | 30,000 | 20,000 | **~50,000** |
| **138 kV Substation** | 2 × 25 MVA transformers + switchyard | 35,000-50,000 | Included | **~42,500** |
| **Bulk Fuel Storage** | Central tank farm + manifolds | 2,000-3,000 | Included | **~2,500** |
| **Total Secured Yards** |  |  |  | **~180,000 SF** |

**Master Plan Allocation:** ~200,000 SF (includes future expansion margin)

## ELECTRICAL YARD CALCULATIONS

### Generator Yard (11 kV Diesel Generators)

**Equipment:** 6 × 4.0 MW @ 11 kV diesel generators (N+1 for 24 MW design load)

**Individual Generator Footprint:** - Generator package (containerized/enclosure): 14 ft W × 40 ft L = **560 SF** - Belly tank (2,000 gal): Integrated within footprint - Service clearance: 8 ft perimeter (all sides) - Total per generator: (14 + 16) × (40 + 16) = 30 ft × 56 ft = **1,680 SF**

**Generator Array:** - 6 generators × 1,680 SF = **10,080 SF** - Layout: 2 rows × 3 generators (with center crane access aisle) - Crane access aisle: 30 ft wide × 120 ft long = **3,600 SF** - **Total generator yard: ~14,000 SF**

### Transformer Yard (11 kV/480V Transformers)

**Equipment:** 8 × 3,500 kVA (11 kV/480V) oil-filled transformers (N+1 redundancy)

**Individual Transformer Footprint:** - Transformer pad: 12 ft W × 14 ft L = **168 SF** - Oil containment: 16 ft W × 18 ft L = **288 SF** - Service clearance: 8 ft perimeter - Total per transformer: (16 + 16) × (18 + 16) = 32 ft × 34 ft = **1,088 SF**

**Transformer Array:** - 8 transformers × 1,088 SF = **8,704 SF** - Layout: 2 rows × 4 transformers (with access aisles) - Access aisles: 20 ft between rows + perimeter access - **Total transformer yard: ~12,000 SF**

### Medium Voltage Switchgear & RMUs

**Equipment:** - 6 × RMUs (Ring Main Units, 11 kV, 630A) - Generator paralleling switchgear - MV cable termination cabinets

**RMU Footprint:** - Each RMU enclosure: 6 ft W × 8 ft L = **48 SF** - Service clearance: 10 ft perimeter - Total per RMU: (6 + 20) × (8 + 20) = 26 ft × 28 ft = **728 SF** - 6 RMUs × 728 SF = **4,368 SF**

**Paralleling Switchgear:** - Outdoor metal-clad switchgear lineup: 8 ft W × 30 ft L = **240 SF** - Service clearance: 10 ft perimeter - Total: (8 + 20) × (30 + 20) = 28 ft × 50 ft = **1,400 SF**

**Termination Cabinets & Control House:** - Control/protection building: 10 ft × 15 ft = **150 SF** - MV cable termination cabinets (multiple): **500 SF**

**Total MV switchgear area: ~6,500 SF**

### Prefabricated Power Delivery Modules (PDMs)

**Equipment:** 2 × PDM containers (LV switchboards, UPS, distribution)

**Individual PDM Footprint:** - PDM container: 10 ft W × 40 ft L = **400 SF** - Service clearance: 8 ft perimeter (electrical code) - Total per PDM: (10 + 16) × (40 + 16) = 26 ft × 56 ft = **1,456 SF**

**PDM Array:** - 2 PDMs × 1,456 SF = **2,912 SF** - Access between PDMs: included in clearances - **Total PDM area: ~3,000 SF**

### Electrical Yard Access & Circulation

**Crane Access:** - Main crane access road: 30 ft wide × 250 ft long = **7,500 SF** - Generator maintenance crane pad: 50 ft × 50 ft = **2,500 SF** - Transformer crane positions: 30 ft × 100 ft = **3,000 SF** - **Total crane access: ~13,000 SF**

**Fire Access:** - Fire lane perimeter: 20 ft wide × 500 ft long = **10,000 SF**

**Emergency/Construction Access:** - East-west emergency access roads: 20 ft wide × 200 ft = **4,000 SF**

**Cable Trenching & Ductbank Zones:** - MV ductbank routes within yard: **3,000 SF** - Fuel manifold trenching: **1,000 SF**

**Total circulation: ~31,000 SF**

### Bulk Fuel Storage

**Central Fuel Tank Farm:** - Above-ground or underground tank(s): ~12,000 gal capacity - Tank footprint (single 12,000 gal tank): 10 ft diameter × 30 ft long = **300 SF** - Spill containment: 20 ft × 40 ft = **800 SF** - Pump house/fill station: 8 ft × 10 ft = **80 SF** - Access road to fill point: 15 ft × 50 ft = **750 SF** - **Total fuel storage area: ~2,000 SF**

**Fuel Manifold:** - Underground piping from bulk storage to each generator - Trenching within yard: Included in electrical yard circulation

### Electrical Yard Summary

| Component | Area (SF) |
| --- | --- |
| Generators (6 units) | 14,000 |
| Transformers (8 units) | 12,000 |
| MV Switchgear & RMUs | 6,500 |
| PDMs (2 units) | 3,000 |
| Bulk Fuel Storage | 2,000 |
| Crane access & circulation | 13,000 |
| Fire lanes | 10,000 |
| Emergency access | 4,000 |
| Cable trenching zones | 4,000 |
| Perimeter buffer (security) | 15,000 |
| **TOTAL ELECTRICAL YARD** | **~83,500 SF** |

**Design Allocation:** **~85,000-100,000 SF** (includes expansion margin)

## MECHANICAL YARD CALCULATIONS

### Chiller Yard (Air-Cooled Chillers)

**Phase 2 Maximum Capacity:** 12 × 1,500 kW air-cooled chillers - Loops 1+2 (air cooling): 4 chillers - Loop 3 (D2C cooling): 8 chillers

**Individual Chiller Footprint:** - Chiller unit: 12 ft W × 30 ft L = **360 SF** - Service clearance: 8 ft perimeter (airflow + maintenance) - Total per chiller: (12 + 16) × (30 + 16) = 28 ft × 46 ft = **1,288 SF**

**Chiller Array:** - 12 chillers × 1,288 SF = **15,456 SF** - Layout: 2 rows × 6 chillers (with center service corridor) - Center service corridor: 15 ft wide × 200 ft long = **3,000 SF** - **Total chiller footprint: ~18,500 SF**

### Pump Houses & Headers

**Primary Pump Stations:** - Loop 1+2 pump house: 10 ft × 15 ft = **150 SF** - Loop 3 pump house: 10 ft × 15 ft = **150 SF** - Service clearance: 8 ft perimeter - Total per pump house: (10 + 16) × (15 + 16) = 26 ft × 31 ft = **806 SF** - 2 pump houses × 806 SF = **1,612 SF**

**Piping Headers & Manifolds:** - Main distribution headers on pipe racks - Header support structures: **1,000 SF**

**Expansion Tanks & Buffer Tanks:** - Glycol expansion tanks (multiple): **500 SF** - Buffer tanks for Loop 3 (fast-acting D2C): **500 SF**

**Total pumps/headers: ~3,600 SF**

### CDU Yard (Coolant Distribution Units for D2C)

**Equipment:** 60 × 300 kW CDUs (Phase 2 D2C cooling)

**CDU Deployment Location:** - **CDUs located inside building envelope** in mechanical gallery (north end of building per floor plan) - **No outdoor yard space required** - CDUs housed in dedicated “Pipe Gallery” zones flanking both data halls - Provides shortest D2C loop lengths to cabinets - Protected environment for critical cooling distribution equipment - Maintains security perimeter (indoor location)

**Design Confirmation:** CDUs deployed **inside building in mechanical galleries** (no outdoor yard space allocated)

### Pipe Rack to Building

**Overhead Pipe Racks:** - Pipe rack from chiller yard to building: 8 ft W × 150 ft L = **1,200 SF** - Multiple pipe racks for Loops 1, 2, 3: 3 racks × 1,200 SF = **3,600 SF** - Pipe rack support columns: Minimal footprint, included in chiller yard

### Mechanical Yard Access & Circulation

**Service Corridors:** - Between chiller rows: 15 ft × 200 ft = **3,000 SF** - Perimeter access roads: 15 ft × 400 ft = **6,000 SF** - **Total service corridors: ~9,000 SF**

**Crane Access:** - Main crane access road: 30 ft wide × 180 ft long = **5,400 SF** - Chiller replacement crane positions: 40 ft × 60 ft = **2,400 SF** - **Total crane access: ~7,800 SF**

**Fire Access:** - Fire lane perimeter: 20 ft wide × 350 ft long = **7,000 SF**

**Emergency/Construction Access:** - East-west emergency access: 20 ft wide × 150 ft = **3,000 SF**

**Total circulation: ~26,800 SF**

### Mechanical Yard Summary

| Component | Area (SF) |
| --- | --- |
| Chillers (12 units) | 18,500 |
| Pump houses & headers | 3,600 |
| CDUs (if outdoor, 60 units) | 0\* |
| Pipe racks to building | 3,600 |
| Service corridors | 9,000 |
| Crane access | 7,800 |
| Fire lanes | 7,000 |
| Emergency access | 3,000 |
| Perimeter buffer | 5,000 |
| **TOTAL MECHANICAL YARD** | **~57,500 SF** |

\* *CDUs assumed deployed inside data halls*

**Design Allocation:** **~50,000-60,000 SF** (adequate for 12 chillers + circulation)

## 138 kV SUBSTATION YARD

### Substation Equipment

**Equipment:** - 2 × 25 MVA transformers (138 kV/11 kV) - 138 kV switchyard (breakers, disconnect switches, bus structures) - Protection & control house

**138 kV Switchyard:** - Single bus configuration with disconnect switches - Bus structure: 30 ft W × 80 ft L = **2,400 SF** - Approach clearances: 25 ft minimum per NESC - Total switchyard footprint: (30 + 50) × (80 + 50) = 80 ft × 130 ft = **10,400 SF**

**138 kV/11 kV Transformers:** - Individual transformer pad: 18 ft W × 24 ft L = **432 SF** - Oil containment: 30 ft W × 40 ft L = **1,200 SF** - Service clearance: 15 ft perimeter (high voltage) - Total per transformer: (30 + 30) × (40 + 30) = 60 ft × 70 ft = **4,200 SF** - 2 transformers × 4,200 SF = **8,400 SF**

**Control House:** - Protection & control building: 15 ft × 25 ft = **375 SF** - Service clearance: 10 ft perimeter - Total: (15 + 20) × (25 + 20) = 35 ft × 45 ft = **1,575 SF**

**Grounding Grid:** - Copper ground grid under entire substation - Footprint: Included in substation yard area

**Access Roads:** - Utility vehicle access: 20 ft wide × 200 ft long = **4,000 SF** - Transformer crane access: 40 ft × 80 ft = **3,200 SF**

**Security Fence:** - 8-10 ft chain-link fence with barbed wire - Perimeter buffer inside fence: 15 ft = **6,000 SF**

**Total Substation Yard:** 10,400 + 8,400 + 1,575 + 4,000 + 3,200 + 6,000 = **~33,600 SF**

**Design Allocation:** **~35,000-50,000 SF** (allows for future expansion bays)

**ROM Allocation Used:** **~42,500 SF** (midpoint)

## SOLAR & BESS AREAS (SEPARATE FROM DATA CENTER)

**Note:** Solar array and BESS are typically owned/operated separately from data center, not included in equipment yard calculations.

### Solar Array (If Adjacent to Site)

**Capacity:** 8+ MW DC solar array

**Footprint Estimate:** - Rule of thumb: 5-7 acres per MW DC for ground-mount solar - 8 MW × 6 acres/MW = **~48 acres** = **~2,090,880 SF**

**Inverter Stations:** - Central inverters (11 kV output): 1,000-2,000 SF per MW - 8 MW × 1,500 SF/MW = **~12,000 SF**

**Solar array is typically on separate parcel or designated zone, not included in equipment yard calculations.**

### BESS (Battery Energy Storage System)

**Capacity:** 4-8 MWh battery storage

**Footprint Estimate:** - Container-based BESS: 8 ft W × 40 ft L per container - Container footprint: **320 SF** - Typical: 1-2 MWh per container - 8 MWh ÷ 2 MWh/container = 4 containers - 4 containers × 320 SF = **1,280 SF** - Service clearance: 10 ft perimeter per NFPA 855 - Total per container: (8 + 20) × (40 + 20) = 28 ft × 60 ft = **1,680 SF** - 4 containers × 1,680 SF = **6,720 SF**

**BESS Inverter/Transformer Pad:** - Bi-directional inverter (11 kV output): **500 SF** - Transformer & switchgear: **800 SF** - Total: **1,300 SF**

**Total BESS Footprint:** 6,720 + 1,300 = **~8,000 SF**

**Fire Access per NFPA 855:** - 20 ft fire lane around BESS enclosure: **5,000 SF**

**Total BESS Area:** **~13,000 SF** (0.3 acres)

**BESS can be integrated near electrical yard or as separate zone.**

## TOTAL SITE EQUIPMENT YARD SUMMARY (24 MW MASTER PLAN)

| Yard Zone | Area (SF) | Area (Acres) | Notes |
| --- | --- | --- | --- |
| **Electrical Yard** | 85,000 | 1.95 | Generators, transformers, MV gear, PDMs, fuel |
| **Mechanical Yard** | 50,000 | 1.15 | Chillers, pumps, pipe racks |
| **138 kV Substation** | 42,500 | 0.98 | Customer-owned substation |
| **BESS (optional)** | 13,000 | 0.30 | Battery energy storage |
| **Subtotal (Core Yards)** | **190,500** | **4.37** | Critical infrastructure |
| **Perimeter Roads & Buffer** | 20,000 | 0.46 | Security perimeter, landscaping buffer |
| **Future Expansion Margin** | 10,000 | 0.23 | Reserved space for Phase 3+ |
| **TOTAL EQUIPMENT YARDS** | **~220,500 SF** | **~5.06 acres** | Secured equipment zones |

**Solar Array (separate):** ~48 acres (if co-located on adjacent parcel)

## DESIGN NOTES

### Space Efficiency

**Current Allocation vs. Design Requirement:** - **Current BOD allocation:** ~150,000 SF (electrical + mechanical yards) - **Calculated requirement:** ~135,000 SF (electrical + mechanical, excluding substation) - **Margin:** +11% buffer

**Including Substation:** - **Current BOD allocation:** Not explicitly separated - **Calculated requirement:** ~177,500 SF (electrical + mechanical + substation) - **Recommended total allocation:** **~200,000 SF** (includes 13% expansion margin)

### Critical Clearances

**NESC/NEC Requirements:** - **138 kV equipment:** 25 ft minimum approach distance - **11 kV equipment:** 10 ft minimum working clearance - **480V equipment:** 3-6 ft working clearance (per NEC)

**Fire Code (IFC/NFPA):** - **Fire lanes:** 20 ft minimum width, 26 ft overhead clearance - **Hydrant spacing:** 500 ft maximum - **Generator separation:** 3 ft minimum between units (or rated enclosure clearance)

**Crane Access:** - **Mobile crane setup:** 50 ft × 50 ft minimum for large equipment - **Generator removal:** 30 ft access aisle minimum

### Layout Optimization Strategies

**Electrical & Mechanical Yard Integration:** - Position mechanical yard south of building (prevailing wind consideration for chiller noise) - Position electrical yard north/east of building (separates noise sources) - Centralize bulk fuel storage at electrical yard perimeter (tanker truck access from perimeter road)

**138 kV Substation Placement:** - Northwest corner of site (utility transmission line approach from north/west typical) - Separate fenced enclosure (security + electrical safety) - Direct 11 kV ductbank route to electrical yard

**Future Expansion:** - Reserve space for 2 additional generators (Phase 3: 30 MW) - Reserve space for 4 additional chillers (Phase 3: 18 MW) - Modular layout allows incremental build-out

## RECOMMENDATIONS

1. **Allocate 200,000 SF total for secured equipment yards** (electrical + mechanical + substation)
   * Electrical yard: 100,000 SF (includes substation, fuel, expansion margin)
   * Mechanical yard: 50,000 SF (adequate for 12 chillers + expansion to 16)
   * Perimeter buffer/roads: 50,000 SF
2. **Separate BESS yard** (if deployed): Allocate 15,000 SF adjacent to electrical yard
3. **Solar array** (if co-located): Reserve 50-60 acres on separate parcel or designated zone
4. **Fire access:** Ensure continuous 20 ft fire lane around all equipment yards with hydrants at 500 ft spacing
5. **Security:** Single perimeter fence encompassing all equipment yards (reduces redundant fencing cost)
6. **Phased Build:** Phase 1 can occupy ~50% of allocated space; reserve remaining for Phase 2/3 expansion

**Tags:** #space-calculations #equipment-yards #master-plan #24mw #site-planning

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