Facility Medical Gas Master Planning

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Your Presenters

Jill Imig

PE, EDAC, ASSE 6060

Senior Plumbing Engineer

Mechanical Department Leader

HGA Architects and Engineers

jimig@hga.com

Ray Schwalbe

PE

Senior Plumbing Engineer

HGA Architects and Engineers

rschwalbe@hga.com

Ryan Hunwardsen

ASSE 6060

Mechanical Engineer

HGA Architects and Engineers

rhunwardsen@hga.com

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Agenda

- Defining Medical Gas Master Planning
- Reasons to Master Plan
- Master Planning in Action
  - Existing and New
- NFPA Requirements – Now and Future

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Defining Medical Gas Master Planning

- Part of overall master planning effort
- Existing Facility Medical Gas Master Planning
- New Construction Medical Gas Master Planning

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Reasons to Master Plan

- Changing acuity and/or care needs
- Large scale projects with significant demand increase or site modifications
- Undersized Central Systems

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Signs of Undersized Central Systems

- Cryogenic Fluid Central Supply Systems (CFCSS) *Previously Bulk Oxygen System*
  - Bulk System fill required 2 weeks or less
  - Frosted/frozen vaporizers
  - Always best to work with the bulk gas supplier
- Medical Vacuum and Medical Air
  - All compressors or pumps running
  - Running compressors or pumps at higher pressures to achieve required outlet pressure
- Patient/Support Gases (O_2, CO_2, N_2O, N_2)
  - Cylinder changeover weekly or more

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Reasons to Master Plan

- Changing acuity and/or care needs
- Large scale projects with significant demand increase or site modifications
- Undersized Central Systems
- Pandemic Planning

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COVID shook up the medical gas industry

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Medical Vacuum (Suction) Use

- Used for suctioning of the airways

Occupancy	Unit of Count	Usage (SCFM)
Med/Surg Patient Room	Bed	0.1
Critical Care / Intensive Care Patient Room	Bed	1.5

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Medical Air & Oxygen Use

- Medical Air is used for blending with Oxygen for patient respiration
- The maximum volume that an adult can breathe is about 30 lpm
- It is not safe to breath pure Oxygen for long periods of time.

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Detail 2.1 Estimates for Gas Consumption by device (usually one per patient)				
Therapy Device	*Total gas*	*FiO_2*	*O_2 Consumption*	*Medical Air Consumption*
Masks / standard nasal cannula	8 *l*pm	30%	0.9	7.1
Reservoir masks and venturi masks	15 *l*pm	30 -50%	1.7 - 5.5	13.3 - 9.4
Standard invasive ventilation (e.g. ICU vents) (except oscillating vents)	12 *l*pm	50%	4.4	7.6
Noninvasive high flow (e.g. HFNC)	50 *l*pm	60%	24.7	25.3
High frequency oscillating ventilators	80 *l*pm	50%	50.6	29.4
Noninvasive other devices	120 *l*pm	60%	59.3	60.7

**Source: BeaconMedaes*

Master Planning an Existing Facility

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Assess Condition of Existing Systems

- Source Equipment
  - What is the age of the equipment?
  - What is the available capacity of the equipment?
  - CFCCS – Consult with vendor
- Pipeline Sizing
  - Any existing pressure issues?
  - Are there too many rooms fed from small piping?
  - What are the calculated system pressure losses?
- Valve Locations
  - Where are the existing service valves?
  - Where are they needed?
  - Are there enough service valves for shutdown flexibility?

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Plan to Address System Shortcomings

- Source Equipment
  - Does old equipment need to be replaced?
  - Does the available capacity meet needs?
  - Would new equipment provide capacity and flexibility?
  - CFCCS – Vendor recommended changes?
- Pipeline Sizing
  - What piping changes can be made?
  - What story do the calculations tell?
- Valve Locations
  - Should service valves be added to existing piping?
  - Can large shutdowns be avoided for new work?

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Existing Facility Master Planning in Action

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Existing Master Planning | Overview

950,000 SF Hospital in Central Wisconsin

Existing Conditions/Concerns

- Aging equipment
- Experiencing medical gas alarms
- Overcrowding due to COVID and Flu

Previous Design Motto: “tap into existing piping at the nearest location”

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Existing Master Planning | A lot of work to be done

Current Project in Construction:

- ED Addition and Remodel

Upcoming Projects

- Inpatient Bed Addition
- Imaging Remodel
- Inpatient Bed Expansion
- ACU Expansion
- Surgery Remodel and Expansion

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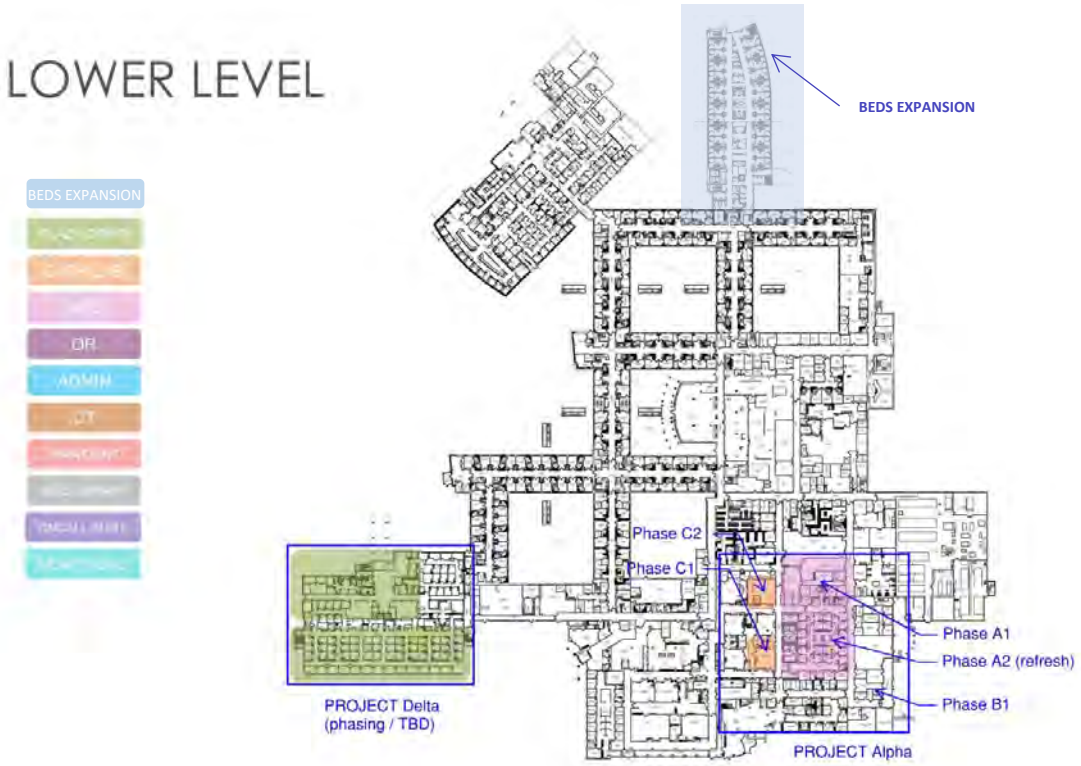
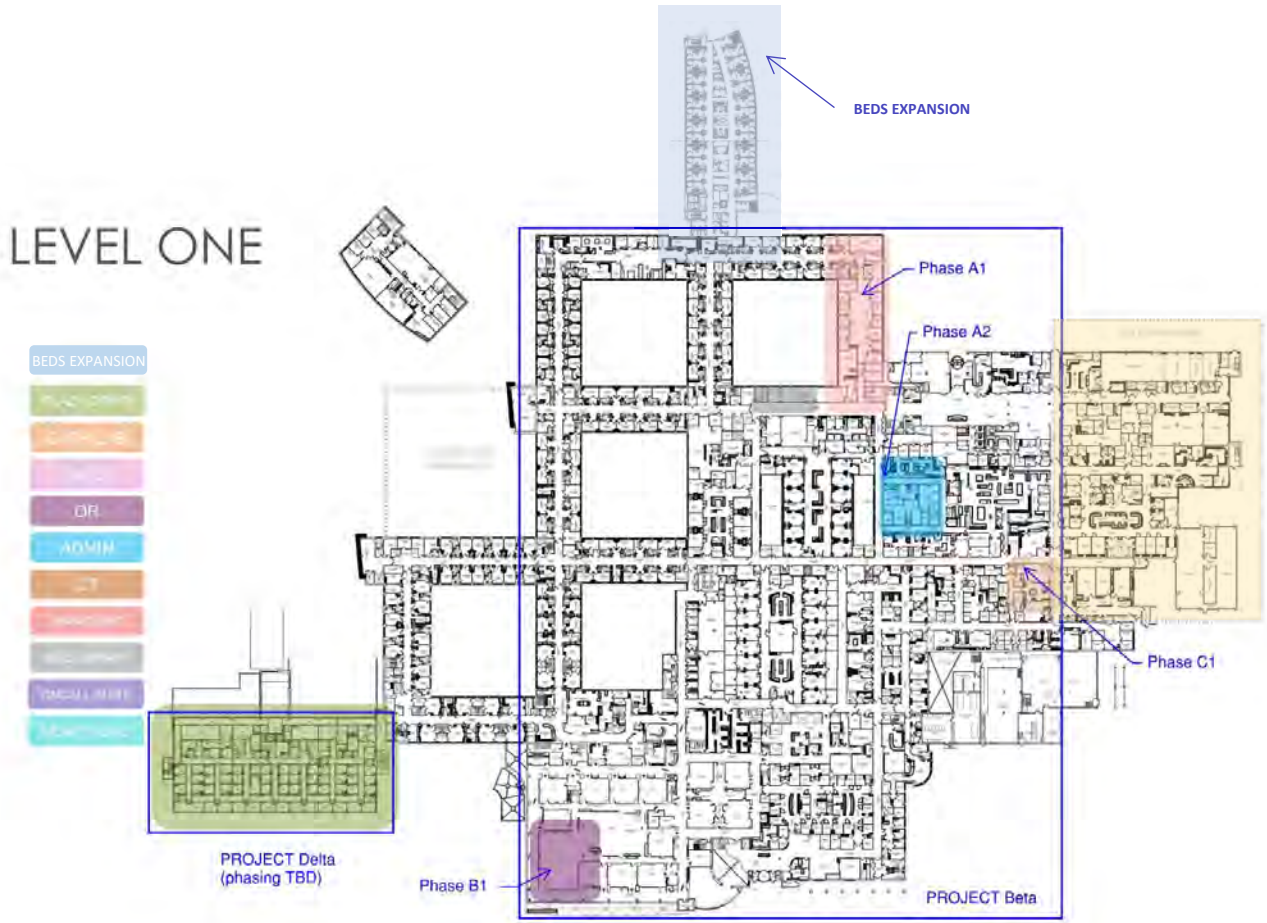
Existing Master Planning | A lot of work to be done





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Existing Master Planning | System Analysis Overview

Room	Oxygen	Vacuum	Air	WAGD	Nitrogen	Nitrous	Carbon Dioxide	Instrument Air	Vacuum Source Sizing: Occupancy	#	units of count	Usage (SCFM)	Total	Med Air Source Sizing: Occupancy	#	units of count	Usage (LPM)	Simultaneous Use	Total
			Level 00 Level 01																
Patient Room - 1-205-00	1	1	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-207-00	1	1	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-209-00	1	1	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-211-00	1	1	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-217-00	1	1	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Iso Room - 1-219-00	1	1	1						Isolation (Infectious Disease)	1	Bed	0.1	0.1	Isolation (Infectious Disease)	1	Bed	30	10%	3
Patient Room - 1-216-00	1	1	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-214-00	1	1	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-212-00	1	1	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-210-00	1	1	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-220-00	1	1	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-542-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-541-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-539-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-540-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-538-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-536-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-413-00	1	1	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-412-00	1	1	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-535-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-537-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-533-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-534-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-531-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-532-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-513-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-512-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-510-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-511-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-509-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-505-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-506-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-504-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-503-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-502-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
Patient Room - 1-422-00	3	2	1						Patient Room (single)	1	Room	0.1	0.1	Patient Room (single)	1	Room	10	10%	1
MRI 1 - 1-997-00	2	2	1	2	2	1			Class 2 Imaging (Procedures)	1	Room	1.5	1.5	Class 2 Imaging (Procedures)	1	Room	14	30%	4.2
MRI 2 - 1-990-00	1	1	1	1	1	1			Class 2 Imaging (Procedures)	1	Room	1.5	1.5	Class 2 Imaging (Procedures)	1	Room	14	30%	4.2
MRI Holding - 1-997-03	1	1	1						Pre-Op/Induction/Holding	1	Bed	0.1	0.1	Pre-Op/Induction/Holding	1				
MRI Mobile Dock - 1-987-03	1	1	1						Class 2 Imaging (Procedures)	1	Room	1.5	1.5	Class 2 Imaging (Procedures)	1	Room	14	30%	4.2
IR Procedure 1-947-00	2	3	3						Class 2 Imaging (Procedures)	1	Room	1.5	1.5	Class 2 Imaging (Procedures)	1	Room	14	30%	4.2
Diagnostic Imaging 1 - 1-943-00	1	1							Class 2 Imaging (Procedures)	1	Room	1.5	1.5						
Diagnostic Imaging 2 - 1-941-00	1	1							Class 2 Imaging (Procedures)	1	Room	1.5	1.5						
Diagnostic Imaging 3 - 1-939-00	1	1							Class 2 Imaging (Procedures)	1	Room	1.5	1.5						
Diagnostic Imaging 4 - 1-937-00	1	1							Class 2 Imaging (Procedures)	1	Room	1.5	1.5						
QC - 1-940-00	1								Class 1 Imaging	1	Room	0.1	0.1						
Ultrasound 4 - 1-953-00	1	1							Class 1 Imaging	1	Room	0.1	0.1						
Ultrasound 3 - 1-954-00	1	1							Class 1 Imaging	1	Room	0.1	0.1						
Ultrasound 2 - 1-955-00	1	1							Class 1 Imaging	1	Room	0.1	0.1						
Ultrasound 1 - 1-956-00	1	1							Class 1 Imaging	1	Room	0.1	0.1						
Prep - 1-977-01	1	1							Pre-Op/Induction/Holding	1	Bed	0.1	0.1						
Prep - 1-977-02	1	1							Pre-Op/Induction/Holding	1	Bed	0.1	0.1						
Prep - 1-977-03	1	1							Pre-Op/Induction/Holding	1	Bed	0.1	0.1						
Prep - 1-977-09	1	1							Pre-Op/Induction/Holding	1	Bed	0.1	0.1						
Prep - 1-977-11	1	1							Pre-Op/Induction/Holding	1	Bed	0.1	0.1						
Prep - 1-977-12	1	1							Pre-Op/Induction/Holding	1	Bed	0.1	0.1						
Spec Camera - 1-962-00	1	1							Class 1 Imaging	1	Room	0.1	0.1						
Gamma Camer - 1-966-00	1	1							Class 1 Imaging	1	Room	0.1	0.1						
Ultrasound - 1-933-00	1	1							Class 1 Imaging	1	Room	0.1	0.1						

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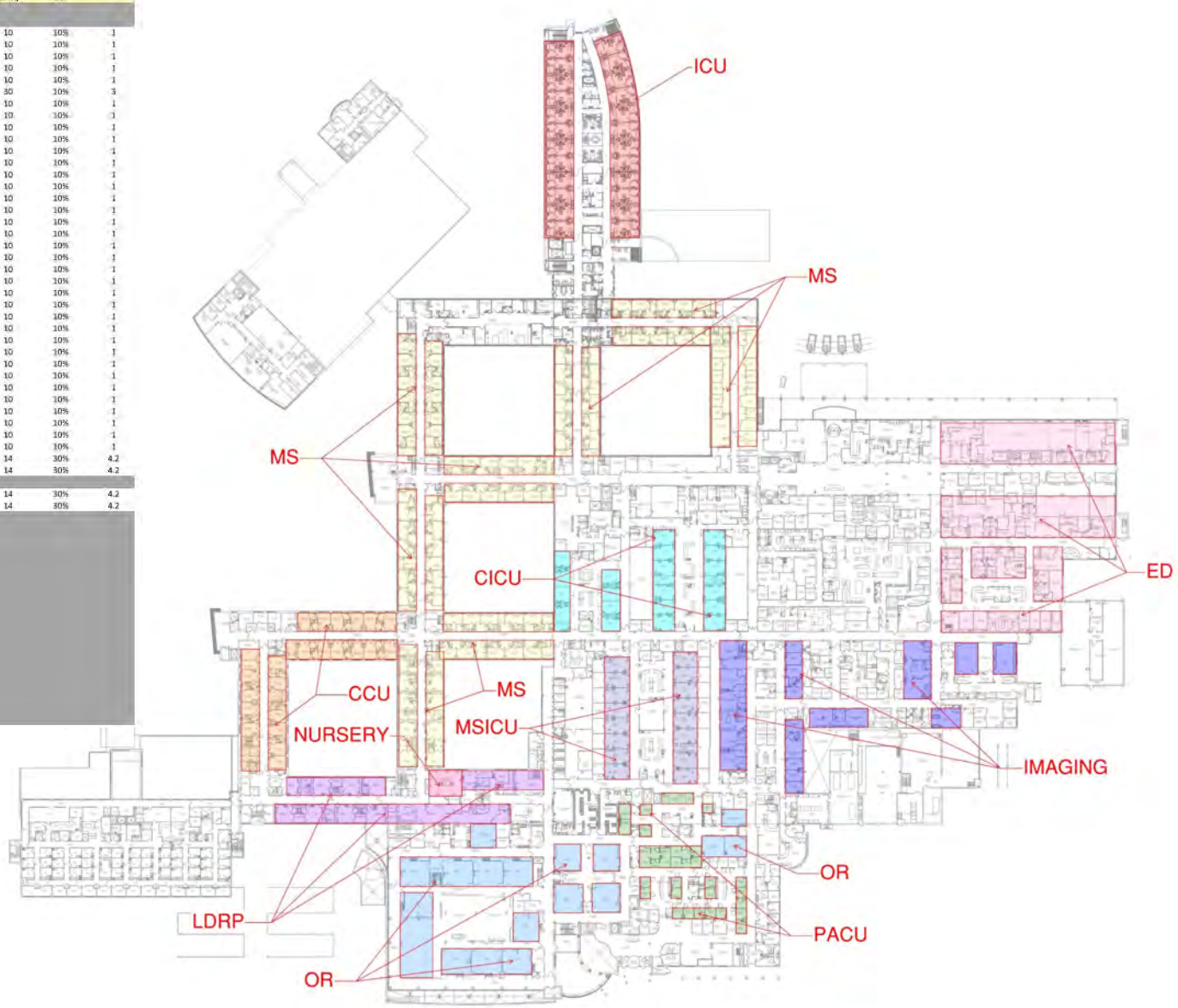

Existing Master Planning | System Analysis Overview

HGA

Medical Vacuum Source Sizing
CGA Method

Occupancy	Existing #	Renovation #	Addition #	Future #	Units of Count	Usage (SCFM)	Existing Total	Renovation Total	Addition Total	Future Total	Total
Autopsy	0	0	0	0	Station	0.4					
Blood Donors	0	0	0	0	Station	0.1					
Demonstration (Inservice)	0	0	0	0	Station	0.5					
Electroconvulsive Therapy	0	0	0	0	Room	0.1					
Hyperbaric holding	0	0	0	0	Bed	0.1					
Intermediate Care / Step down	0	0	0	0	Bed	1					
Isolation (Infectious Disease) not in Critical Care	2	2	0	0	Bed	1	2	2			4
Protective Environment	0	0	0	0	Bed	0.1					
Psychiatric / Secure / Seclusion	0	0	0	0	Bed	0.1					
Recovery (PACU)	14	0	0	0	Bed	0.75	10.5				10.5
Phase 2 recovery (separate from PACU)	29	0	0	0	Bed	0.75	21.75				21.75
Patient Room	243	21	0	0	Bed	0.1	24.3	2.1			26.4
Respiratory Therapy	0	0	0	0	Station	0.5					
Sterilization / Central Supply	1	0	0	0	Station	0.5	0.5				0.5
Endoscopy											
Endoscopy/Catheterization	0	0	0	0	Room	0.1					
Endo holding and recovery	0	0	0	0	Bed	0.1					
Critical Care											
Airborne Infectious Isolation in Critical Care	0	0	0	0	Bed	1.5					
Critical Care (general) / Intensive Care	36	4	48	0	Bed	1.5	54	6	72		132
Emergency											
Holding/Initial Management	13	0	0	0	Bed	0.5	6.5				6.5
Triage (per station)	1	8	0	0	Station	1.5	1.5	12			13.5
Treatment/Trauma	0	2	0	0	Station	1.5		3			3
Observation	6	0	0	10	Bed	0.1	0.6			1	0.6
Treatment	6	19	0	0	Station	0.5	3	9.5			12.5
Cardiac treatment	0	0	0	0	Room	0.5					
Orthopedic/Cast Room	0	0	0	0	Room	0.1					
Imaging											
Class 1 Imaging	15	1	0	0	Room	0.1	1.5	0.1			1.6
Class 2 Imaging (Procedures)	5	1	0	0	Room	1.5	7.5	1.5			9
Class 3 Imaging (Interventional)	2	0	0	0	Room	3.5	7				7
Obstetrics											
Caesarean Delivery Room	0	0	0	0	Room	1					
Labor/Delivery/Recovery (LDR)	0	0	0	0	Room	1					
Labor/Delivery/Recovery/Postpartum (LDRP)	12	0	0	0	Room	1	12				12
Antepartum / Postpartum	0	0	0	0	Bed	0.1					
Caesarean Recovery	0	0	0	0	Bed	0.75					
Infant Resuscitation	1	0	0	0	Bed	0.5	0.5				0.5
Operating Rooms											
Anesthesia Workroom	1	0	0	0	Station	0.1	0.1				0.1
Operating Rooms	32	2	0	0	Room	3.5	112	7			119
[illegible]											
Pediatric Critical Care	0	0	0	0	Bed	1.2					
Neonatal ICU (all levels)	14	0	0	0	Bed	0.5	7				7
Nursery	10	1	0	0	Bed	0.1	1	0.1			1.1
Continuing Care Nursery	0	0	0	0	Bed	0.1					
Pediatric and Adolescent bed	0	0	0	0	Bed	0.1					
WAGD (if dual use systems are employed)	0	0	0	0	Room	2					
						Peak Calculated Demand (SCFM)	273.25	43.3	72	1	388.55

HGA

Medical Air Source Sizing
US Typical Method

Occupancy	Existing #	Renovation #	Addition #	Future #	Units of Count	Usage (SCFM)	Usage (LPM)	Simultaneous Use	Existing Total (SCFM)	Renovation Total (SCFM)	Addition Total (SCFM)	Future Total (SCFM)	Total (SCFM)
Blood Donors	0	0	0	0	Station	0.5	14	5%					
Demonstration (Inservice)	0	0	0	0	Station	0.5	14	10%					
Dental Treatment	0	0	0	0	Station	0.5	14	10%					
Electroconvulsive Therapy	0	0	0	0	Room	0.5	14	20%					
Intermediate Care/Step Down	0	0	0	0	Bed	0.5	14	25%					
Isolation (All) - Not Critical Care	2	2	0	0	Bed	1	30	20%	0.40	0.40			0.80
Protective Environment	0	0	0	0	Bed	1	30	10%					
Psychiatric / Secure / Seclusion	0	0	0	0	Bed	0.5	14	10%					
Recovery/PACU	14	0	0	0	Bed	2	57	30%	8.40				8.40
Phase 2 Recovery (separate from PACU)	29	0	0	0	Bed	1	30	10%	2.90				2.90
Patient Room	243	21	0	0	Bed	0.4	10	10%	9.72	0.84			10.56
Respiratory Therapy	1	0	1	0	Station	1	30	50%	0.50		0.50		1.00
Endoscopy													
Endoscopy / Catheterization	0	0	0	0	Room	0.5	14	10%					
Endo holding and recovery	0	0	0	0	Bed	0.4	10	10%					
Critical Care:													
Airborne Infectious Isolation in Critical Care	0	0	0	0	Bed	2	57	50%					
Critical Care / Intensive Care	36	4	48	0	Bed	2	57	50%	36.00	4.00	48.00		88.00
Emergency:													
Holding/Initial Management	13	0	0	0	Bed	2	57	10%	2.60				2.60
Triage (per station)	1	8	0	0	Station	2	57	50%	1.00	8.00			9.00
Treatment/Trauma	0	2	0	0	Station	2	57	20%		0.80			0.80
Observation	0	0	0	10	Bed	0.4	10	10%				0.40	0.40
Treatment	3	19	0	0	Station	0.5	14	25%	0.38	2.38			2.75
Cardiac Treatment	0	0	0	0	Room	0.5	14	25%					
Orthopedic/Cast Room	0	0	0	0	Room	0.5	14	10%					
Imaging:													
Class 1 Imaging	5	1	0	0	Room	0.4	10	10%	0.20	0.04			0.24
Class 2 Imaging (Procedures)	1	1	0	0	Room	0.5	14	30%	0.15	0.15			0.30
Class 3 Imaging (Interventional)	2	0	0	0	Station	0.4	57	30%	0.24				0.24
Obstetrics:													
Caesarean Delivery Room	0	0	0	0	Room	0.7	20	100%					
Labor/Delivery/Recovery (LDR)	0	0	0	0	Room	0.5	14	25%					
Labor/Delivery/Recovery/Postpartum (LDRP)	12	0	0	0	Room	0.5	14	25%	1.50				1.50
Antepartum/Post Partum	0	0	0	0	Bed	0.4	10	10%					
Caesarean Recovery	0	0	0	0	Bed	2	57	25%					
Infant Resuscitation	1	0	0	0	Station	0.4	10	30%	0.12				0.12
Operating Rooms:													
Anesthesia Workroom	0	0	0	0	Station	0.4	10	10%					
Operating Rooms	32	2	0	0	Station	0.4	10	10%	1.28	0.08			1.36
[illegible]													
Pediatric Critical Care	0	0	0	0	Bed	2	57	50%					
Neonatal ICU (all levels)	14	0	0	0	Bed	1.5	42	75%	15.75				15.75
Nursery	10	1	0	0	Bed	0.5	14	25%	1.25	0.13			1.38
Continuing Care Nursery	0	0	0	0	Bed	0.5	14	25%					
Pediatric and Adolescent	0	0	0	0	Bed	0.5	14	10%					
Ventilators:													
Standard Ventilator	0	0	0	0	Each	1	25	50%					
Oscillating Ventilator	0	0	0	0	Each	2.5	75	75%					
								Peak Calculated Demand (SCFM)	82.39	16.81	48.50	0.40	148.10

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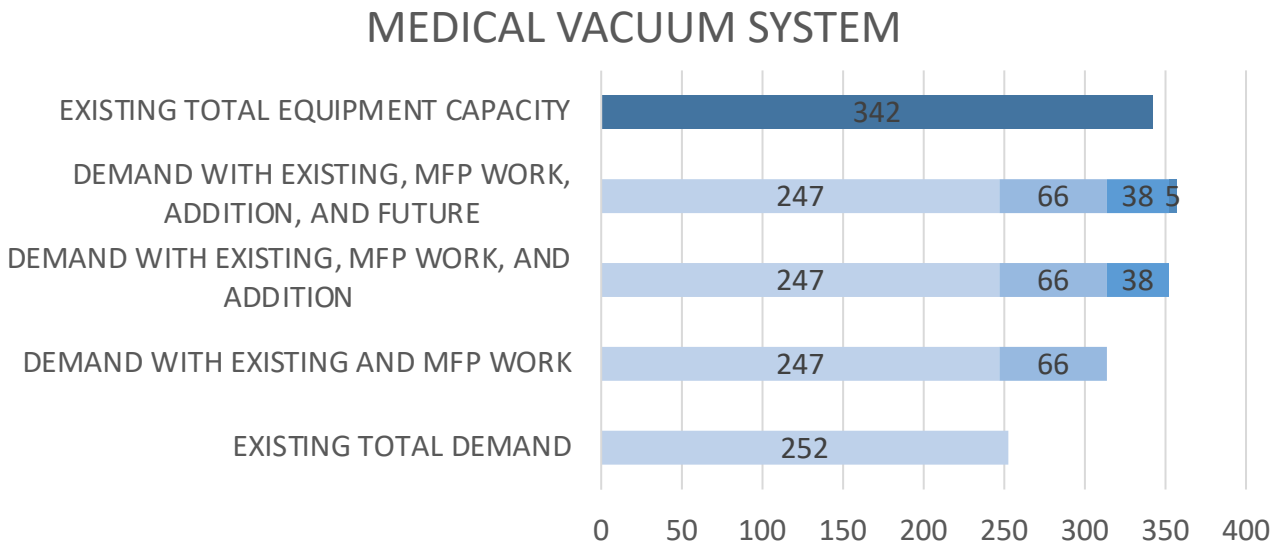
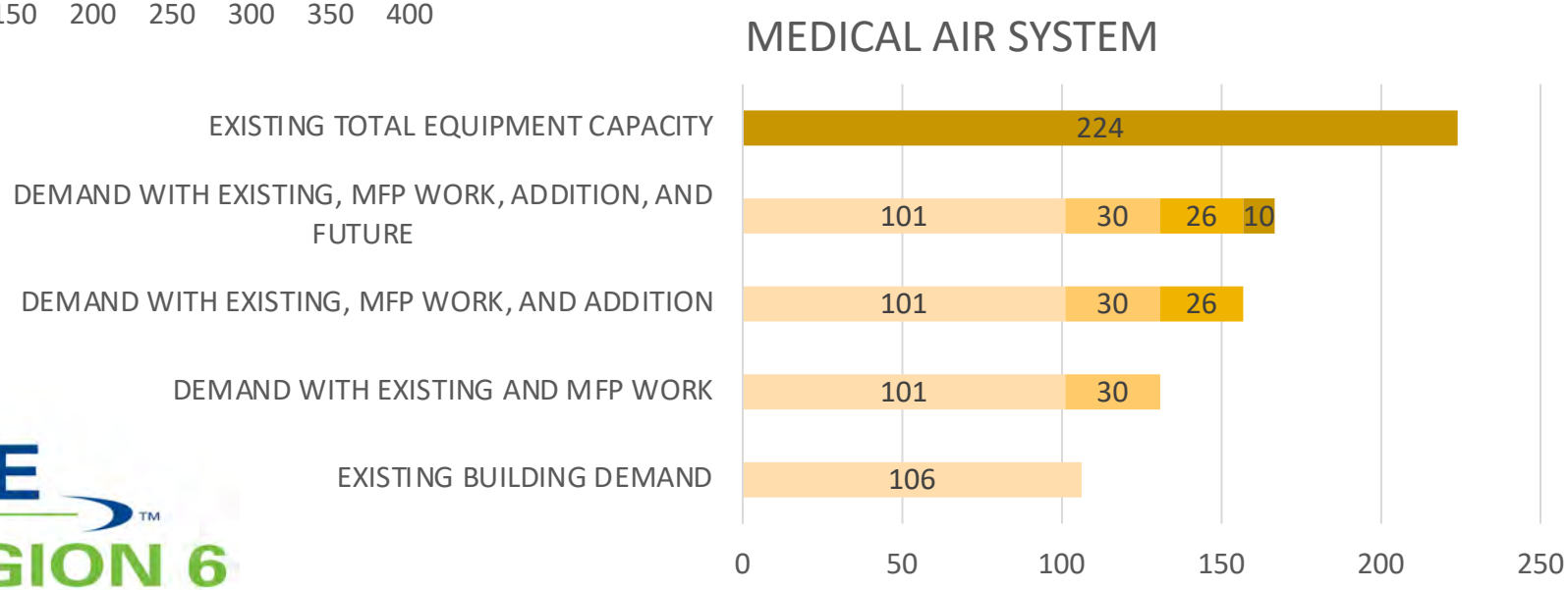
Existing Master Planning | System Analysis Results





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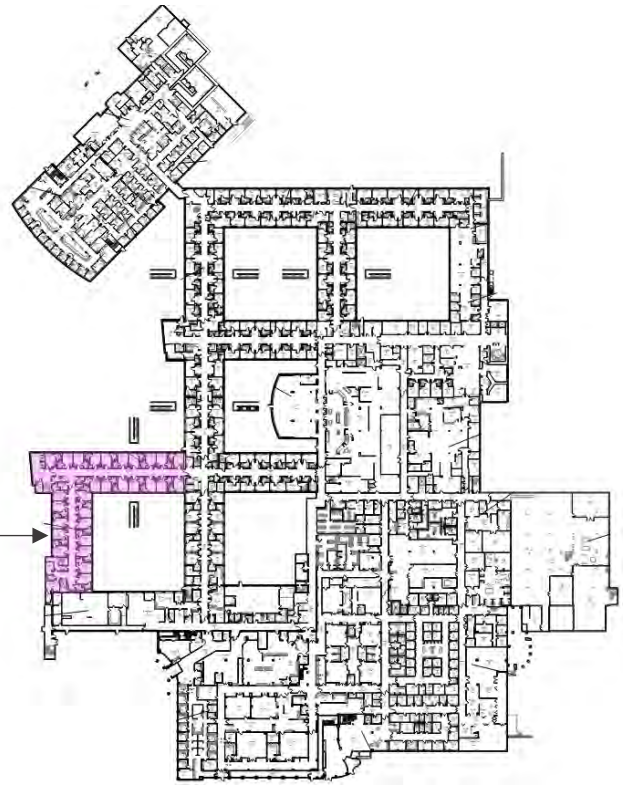
Existing Master Planning | Pandemic Response

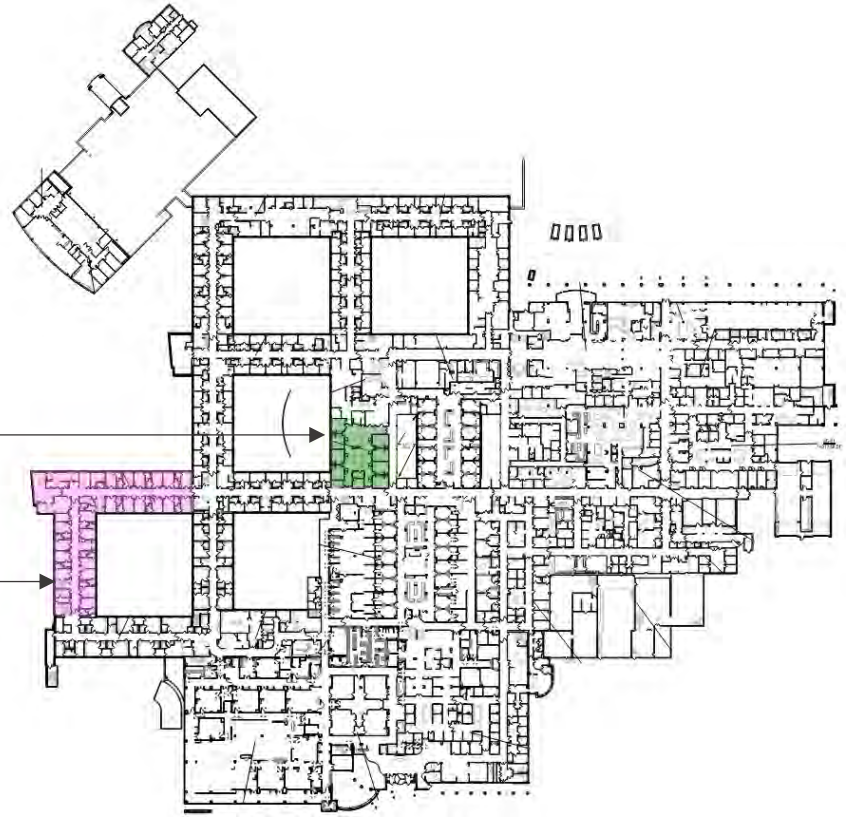
Temporary CCU for COVID Overflow



Lower Level

Temporary ICU for COVID

Temporary CCU for COVID Overflow



Level One

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Existing Master Planning | Pandemic Response

- Facility has 42 ventilators total
- Common to run 25-35 ventilators per day
- About ½ of the COVID patients were on ventilators, ½ HFNC

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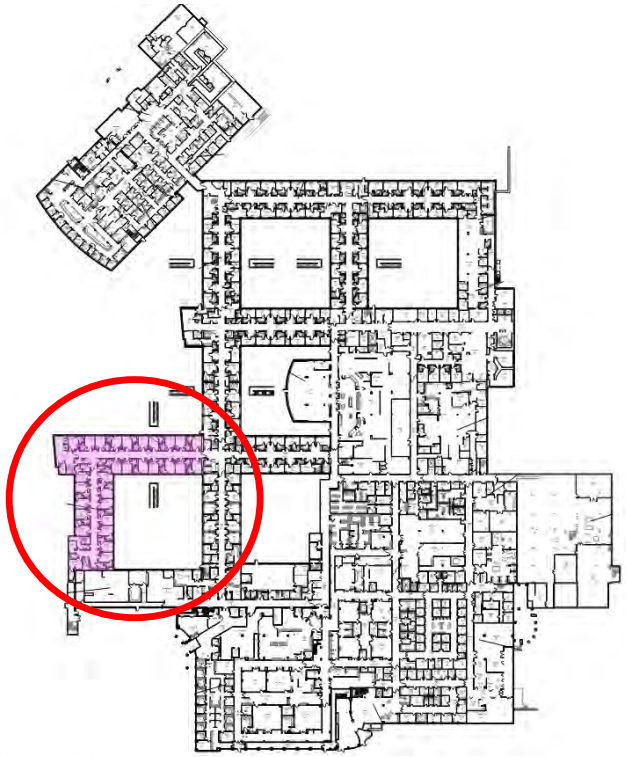
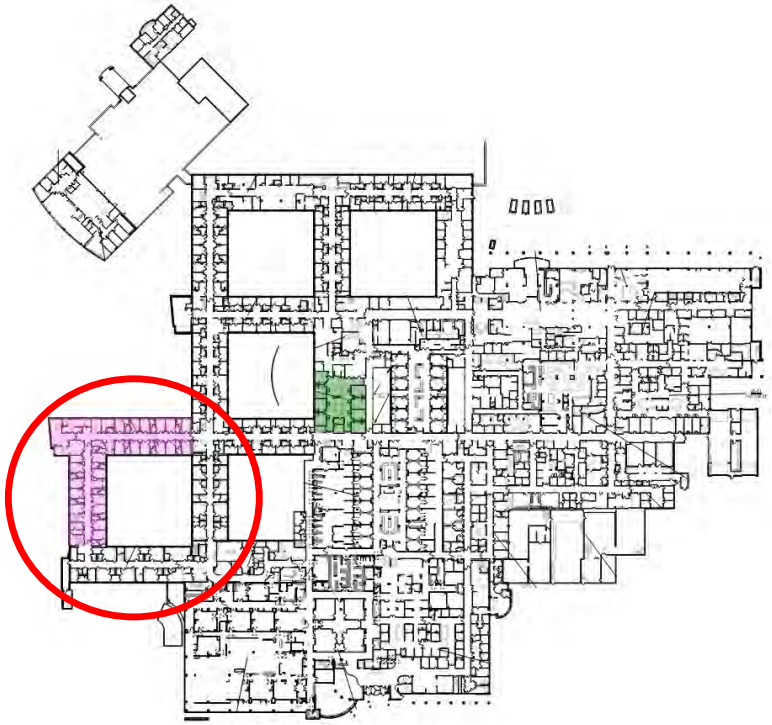
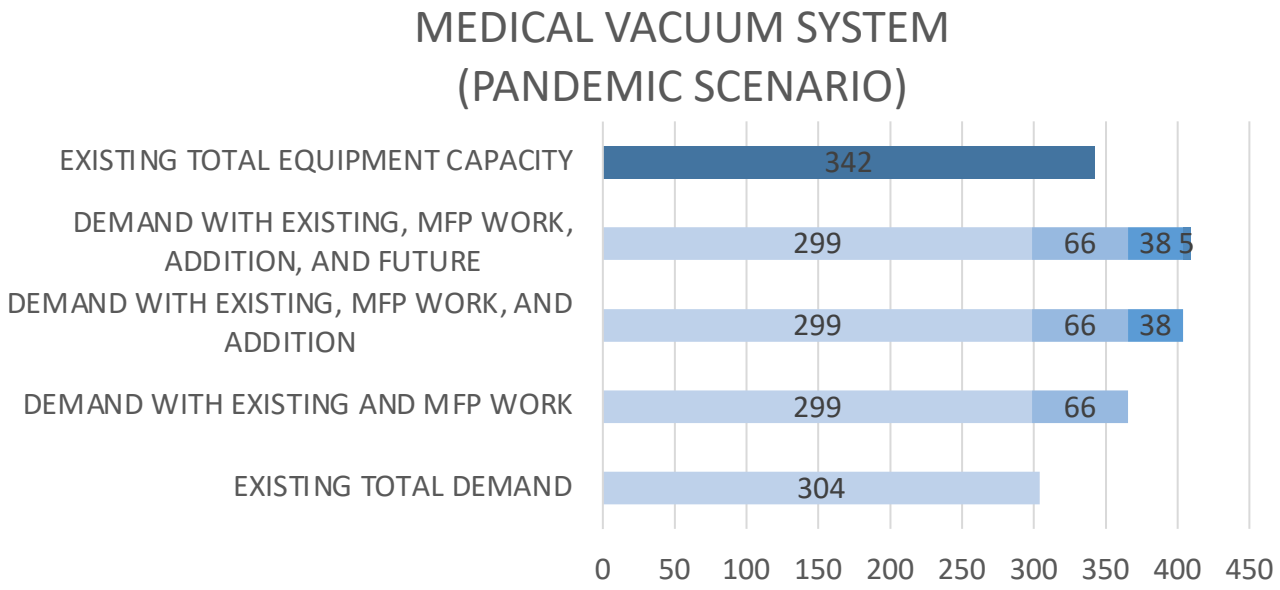


Lower Level



Level One

Existing Master Planning | Pandemic Analysis Results



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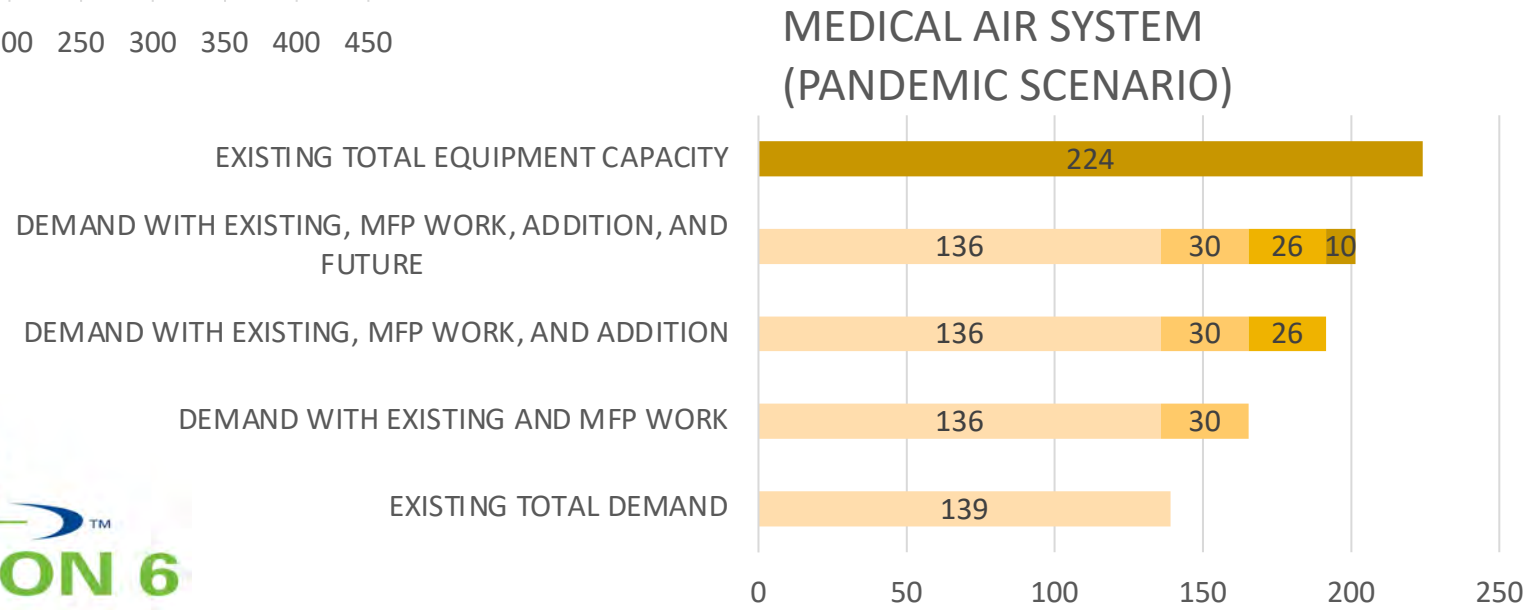

Existing Master Planning | Piping Analysis Overview


Project Name: CARE PAVILLION

Medical Vacuum (19inHgV) Tabulation

Oxygen (55psi) Tabulation

Medical Air (55psi) Tabulation

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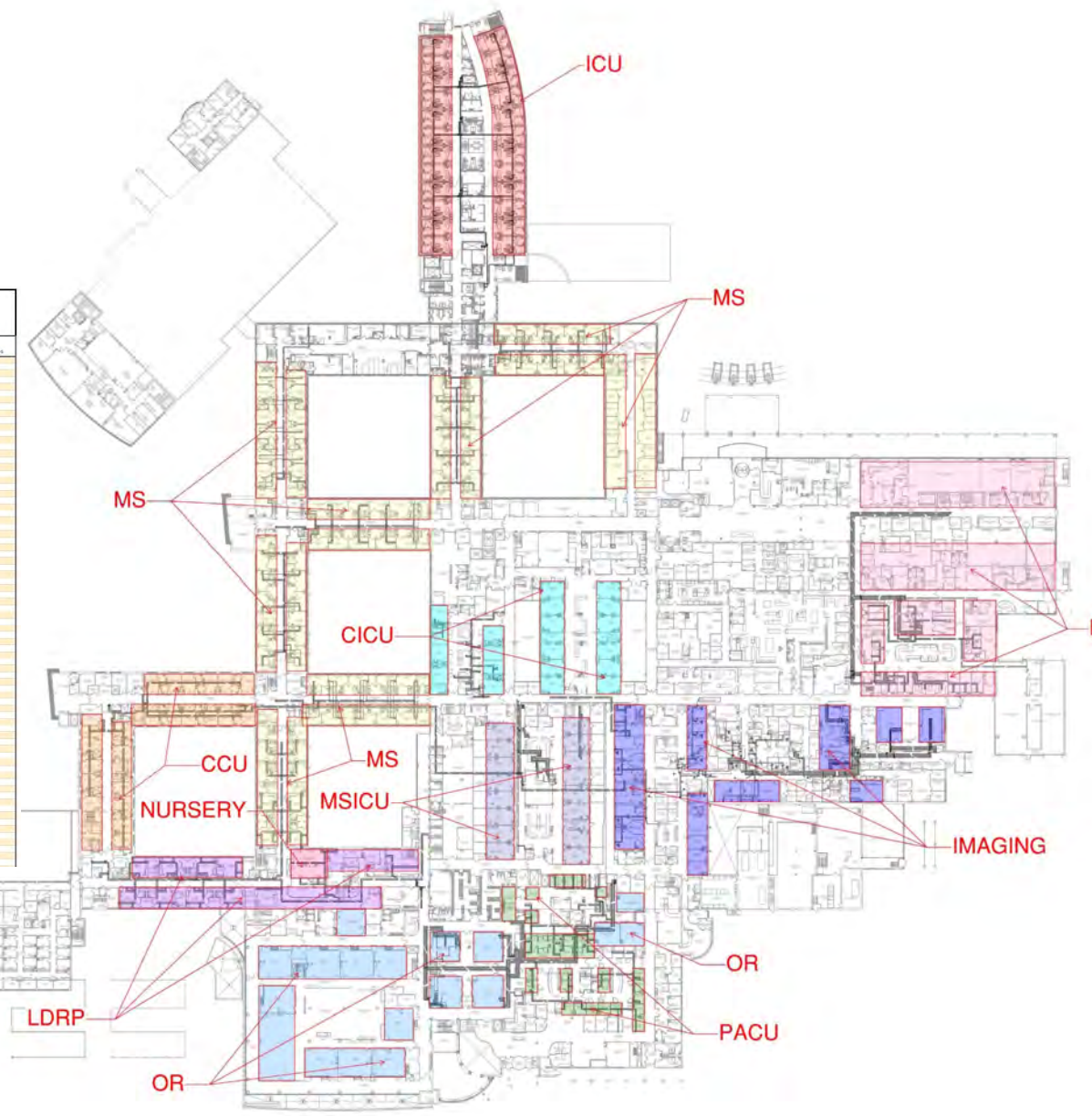
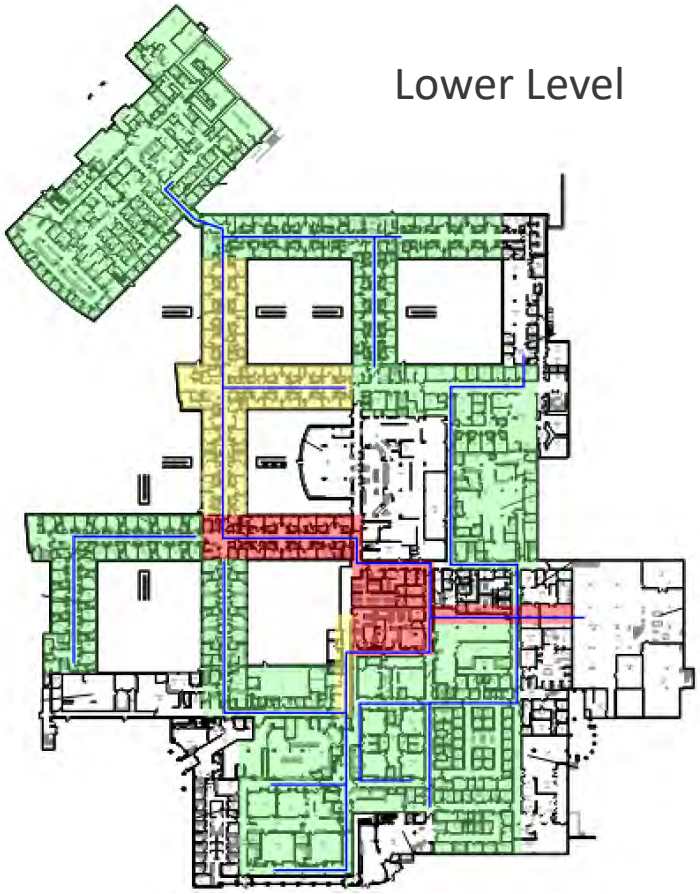
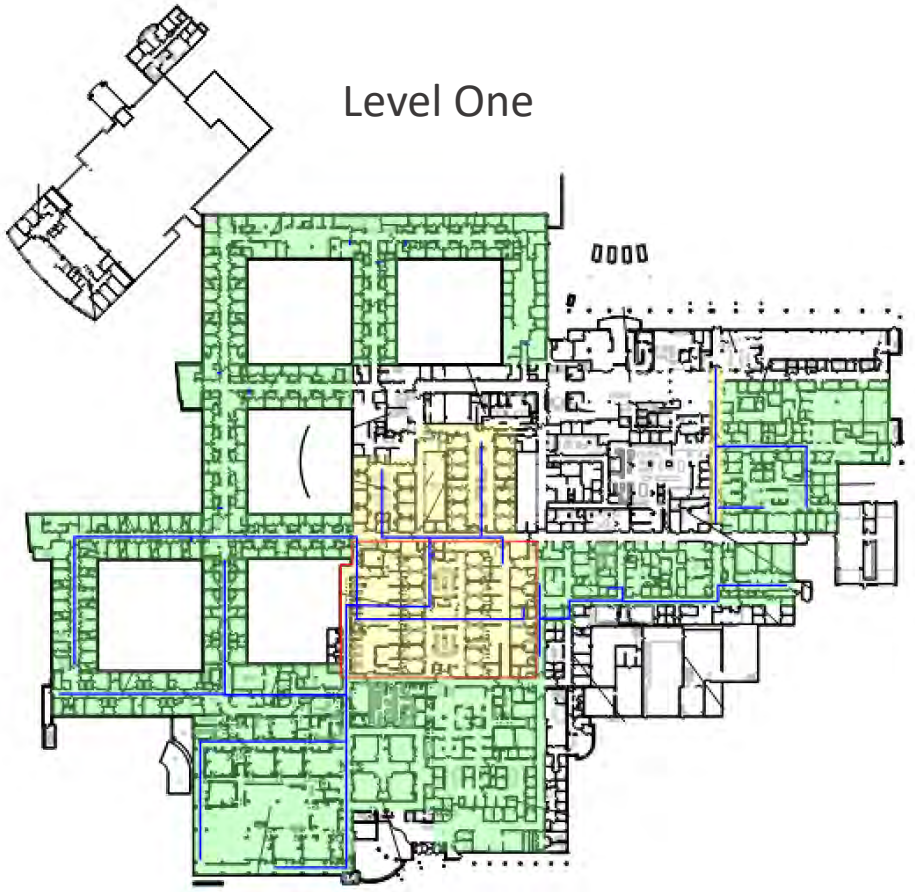


Existing Master Planning | Piping Analysis Results

Lower Level



Level One



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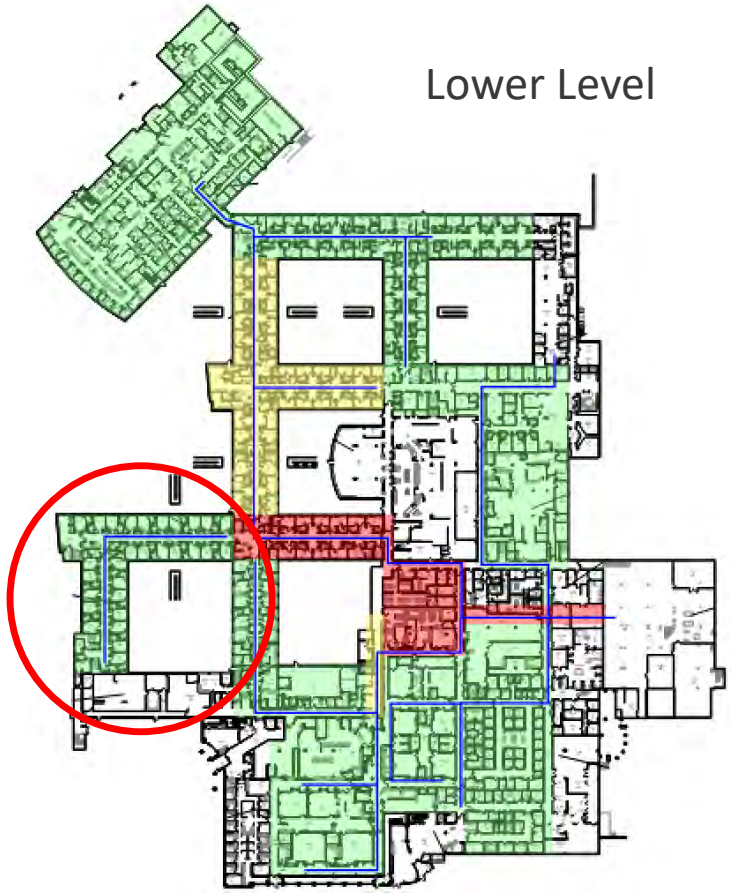
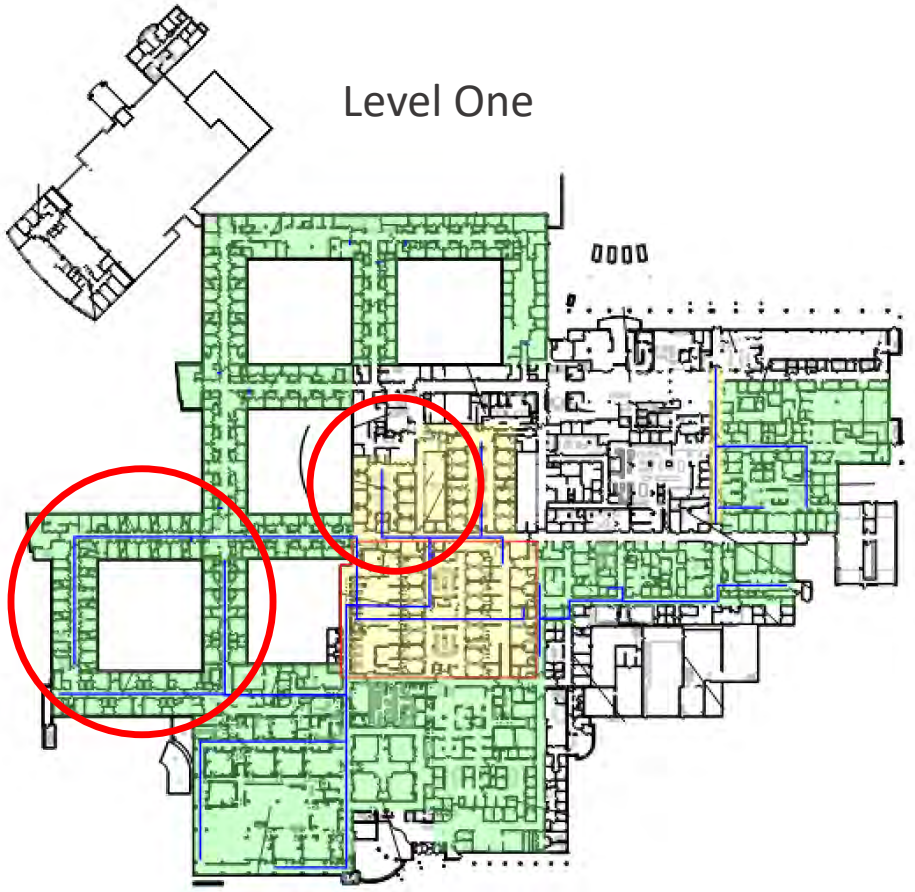
Existing Master Planning | Piping Analysis Results

Lower Level



Level One



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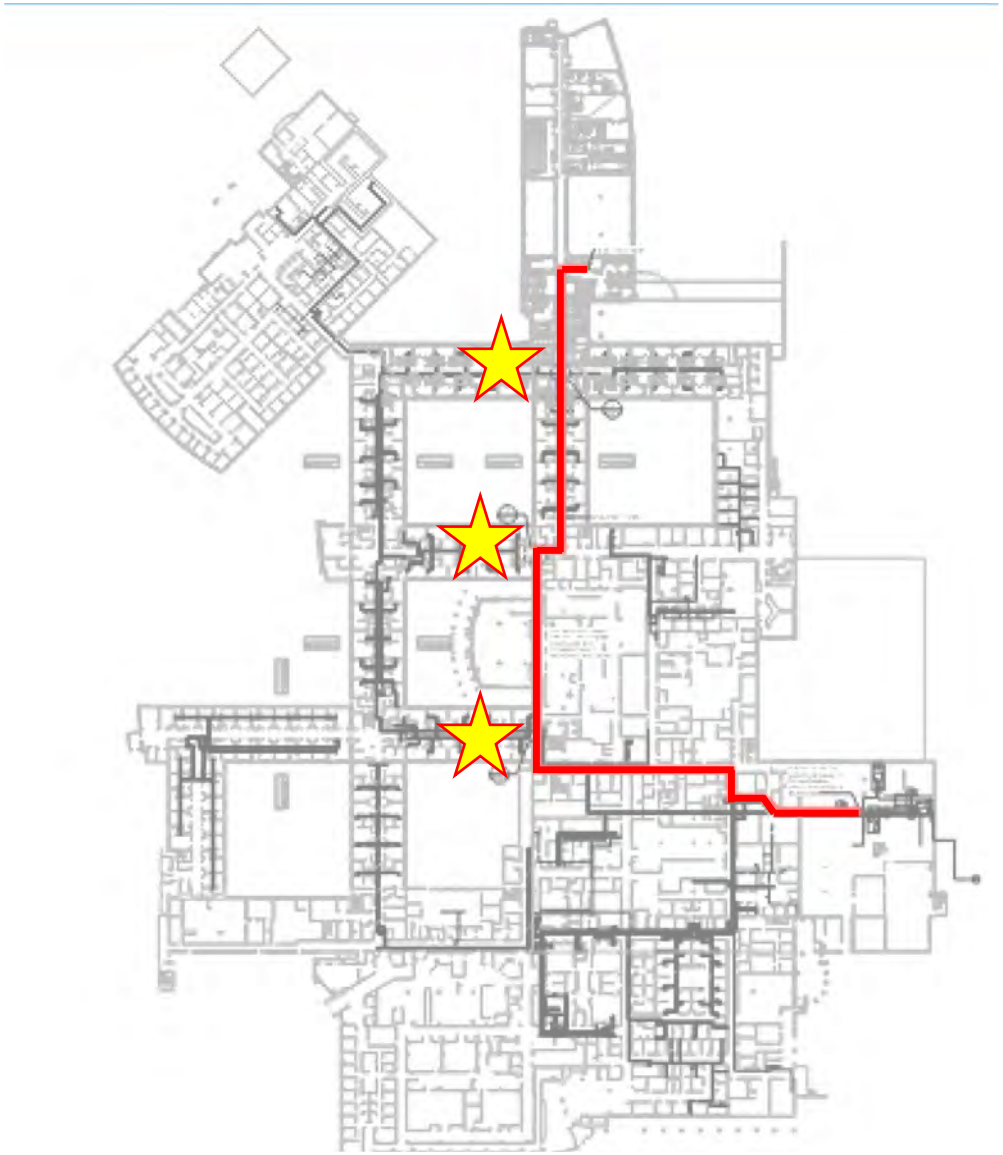
Existing Master Planning | Corrective Actions

- New custom Contactless Claw Pentaplex expandable to Heptaplex Stack mounted Medical Vacuum System
- Confirmed recently installed Medical Air System was adequately sized
- Setup for future independent connection for surgery suite
- New full sized distributed piping to addition to allow for load shedding of existing system



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Master Planning a New Project

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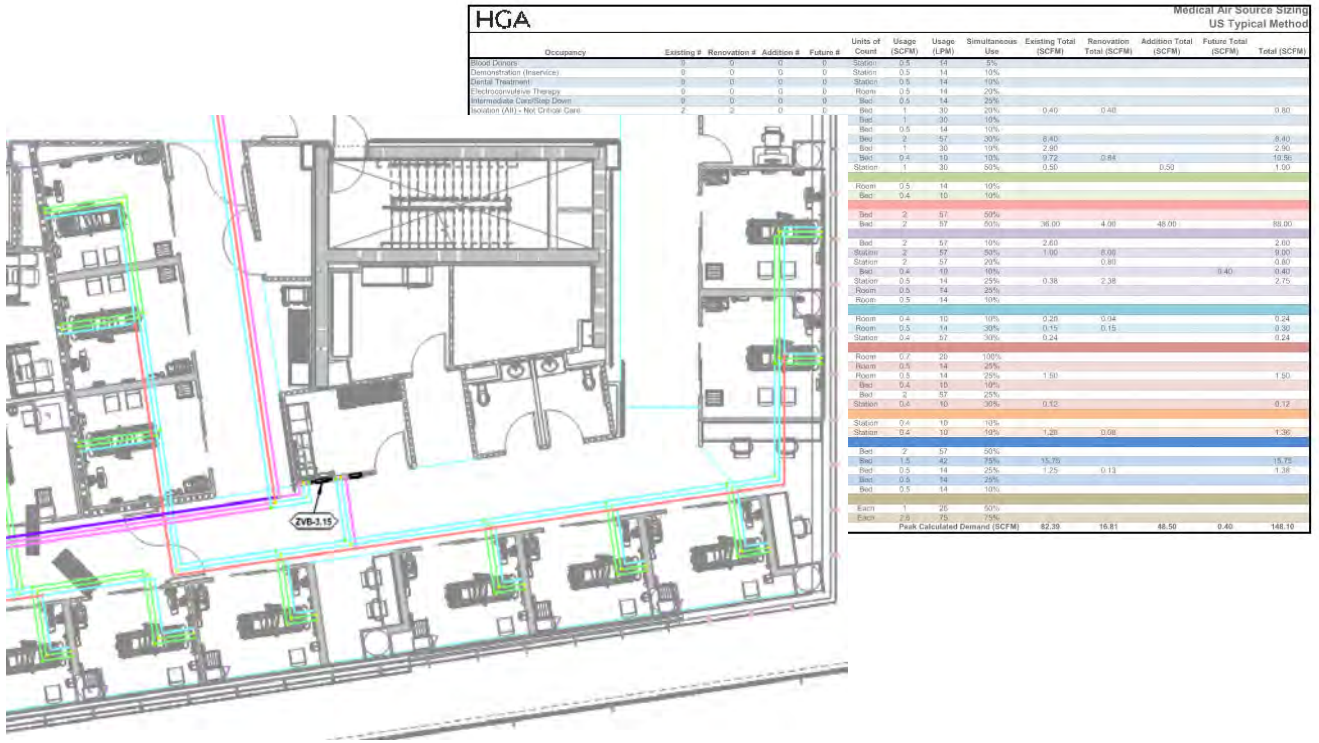
Planning for Future Facility Needs

- Source Equipment
  - What type of equipment best suits todays needs? Tomorrows?
  - What is our system capacity?
  - Does this system adapt to potential changing care needs?

- Pipeline Sizing
  - What are the calculated system pressure losses?
  - Can the piping system adapt to changing space use?

- Valve Locations
  - Where are we locating service valves?
  - Should valved connections be added now for future projects?
  - Do we have auxiliary source connections identified?



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New Project Master Planning in Action

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New Master Planning | Facility Overview

Ninth Level	Shell
Eighth Level	MS IP (48)
Seventh Level	MS IP (48)
Sixth Level	MS IP (18) MS ICU (30)
Fifth Level	CV IP (14) CV ICU (32)
Fourth Level	OR PACU/ Prep & Recov
Third Level	Single Level OR/iMRI
Second Level	Endo, IR & Prep & Recov
First Level	ED Parking | Café/Lobby
Lower Level	Kitchen, SPD, Support

Day 1 – 190 beds

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New Master Planning | Facility Overview

	Day 1 – 190 beds	Day 2 – 238 beds
Ninth Level	Shell	**MS IP (48)**
Eighth Level	MS IP (48)	MS IP (48)
Seventh Level	MS IP (48)	MS IP (48)
Sixth Level	MS IP (18) MS ICU (30)	**MS IP (12) MS ICU (36)**
Fifth Level	CV IP (14) CV ICU (32)	**CV IP (5) CV ICU (41)**
Fourth Level	OR PACU/ Prep & Recov	OR PACU/ Prep & Recov
Third Level	Single Level OR/iMRI	Single Level OR/iMRI
Second Level	Endo, IR & Prep & Recov	Endo, IR & Prep & Recov
First Level	ED Parking / Café/Lobby	ED Parking / Café/Lobby
Lower Level	Kitchen, SPD, Support	Kitchen, SPD, Support

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New Master Planning | Facility Overview

	Day 1 – 190 beds	Day 2 – 238 beds	Pandemic Mode – 238 beds
Ninth Level	Shell	**MS IP (48)**	Shell
Eighth Level	MS IP (48)	MS IP (48)	**Pandemic ICU (48)**
Seventh Level	MS IP (48)	MS IP (48)	MS IP (48)
Sixth Level	MS IP (18) MS ICU (30)	**MS IP (12) MS ICU (36)**	MS IP (18) MS ICU (30)
Fifth Level	CV IP (14) CV ICU (32)	**CV IP (5) CV ICU (41)**	CV IP (14) CV ICU (32)
Fourth Level	OR PACU/ Prep & Recov	OR PACU/ Prep & Recov	OR PACU/ Prep & Recov
Third Level	Single Level OR/iMRI	Single Level OR/iMRI	Single Level OR/iMRI
Second Level	Endo, IR & Prep & Recov	Endo, IR & Prep & Recov	Endo, IR & Prep & Recov
First Level	ED Parking / Café/Lobby	ED Parking / Café/Lobby	ED Parking / Café/Lobby
Lower Level	Kitchen, SPD, Support	Kitchen, SPD, Support	Kitchen, SPD, Support

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New Master Planning | System Analysis Overview

Day 1

Medical Vacuum System

78% Capacity

Medical Air System

79% Capacity

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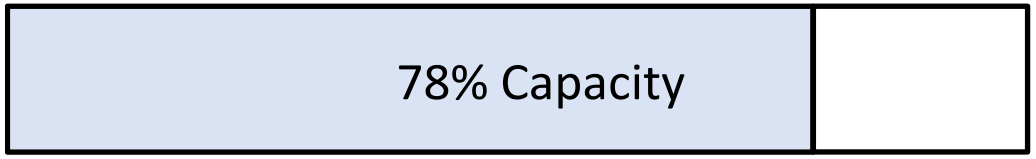
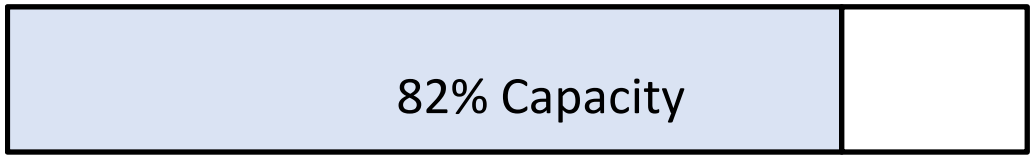
New Master Planning | System Analysis Overview

Medical Vacuum System

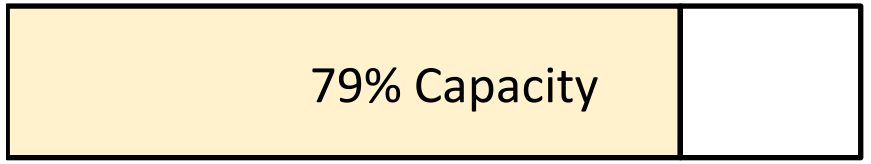
Day 1

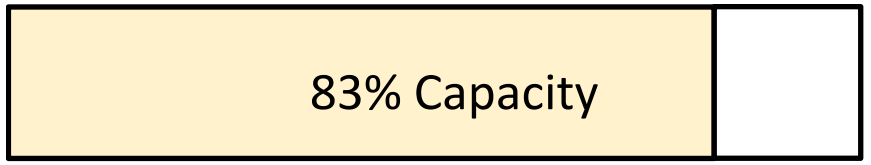


Day 2



Medical Air System





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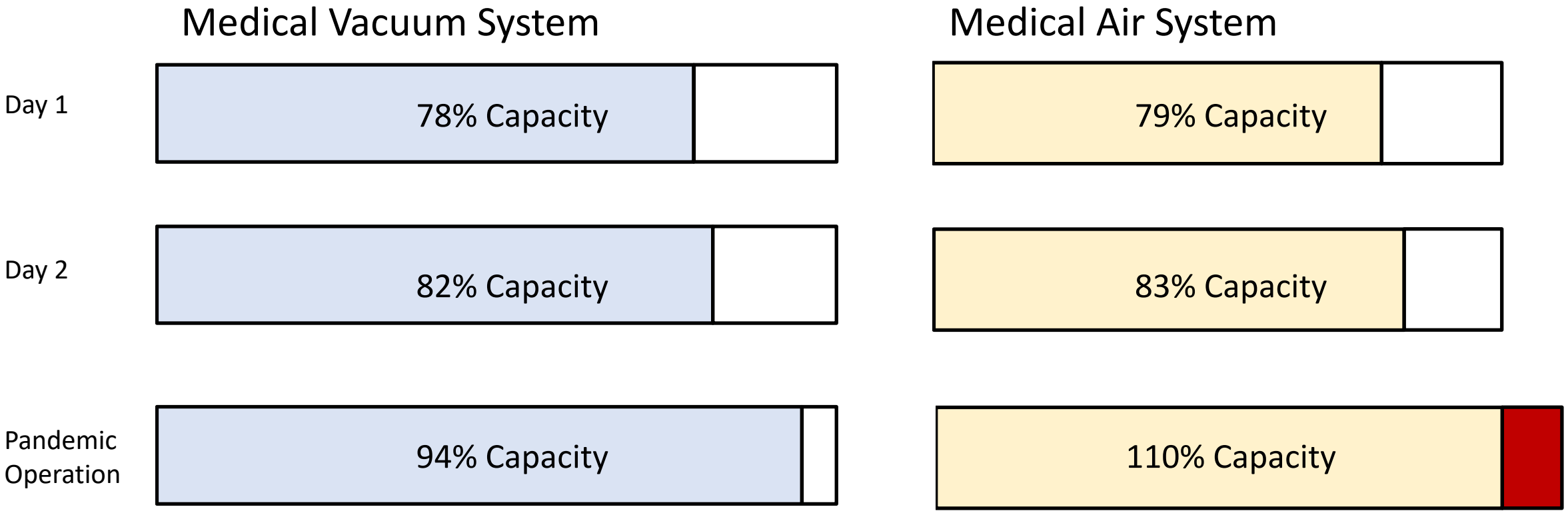
New Master Planning | System Analysis Overview



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New Master Planning | System Analysis Overview

	Medical Vacuum System	Medical Air System
Day 1	78% Capacity	79% Capacity
Day 2	82% Capacity	83% Capacity
Pandemic Operation	94% Capacity	88% Capacity

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New Master Planning | Piping Analysis Overview

Segment Start	Segment End	Measured Length	System Pressure @ Beginning of Section (psi)	Quantity of outlets/rooms	Flow Per Outlet (LPM)	Design Flow For Branch (LPM)	Design Flow for Section	Pipe Size	Pressure Drop for Section (psi)	System Pressure at end of Section (psi)
ZVB-8.5										
CP8018	CP8016	40	55	2	10	20	20	1/2"	0.0066	54.9934
CP016	CP8014	4	54.9934	2	10	20	40	3/4"	0.00036	54.99304
CP8014	CP8012	26	54.99304	2	10	20	20	3/4"	0.00078	54.99226
CP012	CP8010	4	54.99226	2	10	20	60	3/4"	0.00078	54.99148
CP8010	BRANCH	10	54.99148	2	10	20	40	3/4"	0.0009	54.99058
BRANCH	ZVB-8.5 TO MAIN TO ZVB-8.4	185	54.99058	6	10	60	120	3/4"	0.113775	54.876805
ZVB-8.4	ZVB-8.3	40	54.876805	16	10	160	280	1"	0.0306	54.846205
ZVB-8.3	RISER	25	54.846205	14	10	140	420	1"	0.043875	54.80233
CP8004	CP8006	40	55	2	10	20	20	1/2"	0.0066	54.9934
CP8006	CP8008	4	54.9934	2	10	20	40	3/4"	0.00036	54.99304
CP8008	BRANCH	18	54.99304	2	10	20	60	3/4"	0.00351	54.98953
ZVB-8.5										
CP8018	CP8016	40	55	2	25	50	50	1/2"	0.0306	54.9694
CP016	CP8014	4	54.9694	2	25	50	100	3/4"	0.0018	54.9676
CP8014	CP8012	26	54.9676	2	25	50	50	3/4"	0.00351	54.96409
CP012	CP8010	4	54.96409	2	25	50	150	3/4"	0.00408	54.96001
CP8010	BRANCH	10	54.96001	2	25	50	100	3/4"	0.0045	54.95551
BRANCH	ZVB-8.5 TO MAIN TO ZVB-8.4	185	54.95551	6	25	150	300	3/4"	0.568875	54.386635
ZVB-8.4	ZVB-8.3	40	54.386635	16	25	400	700	1"	0.1542	54.232435
ZVB-8.3	RISER	25	54.232435	14	25	350	1050	1"	0.215625	54.01681
CP8004	CP8006	40	55	2	25	50	50	1/2"	0.0306	54.9694
CP8006	CP8008	4	54.9694	2	25	50	100	3/4"	0.0018	54.9676
CP8008	BRANCH	18	54.9676	2	25	50	150	3/4"	0.01836	54.94924

- Grey – M/S Room Operation
- Purple – Pandemic Operation

- Additional 0.8 PSI drop for floor
- Roughly 20% of system allowable pressure drop

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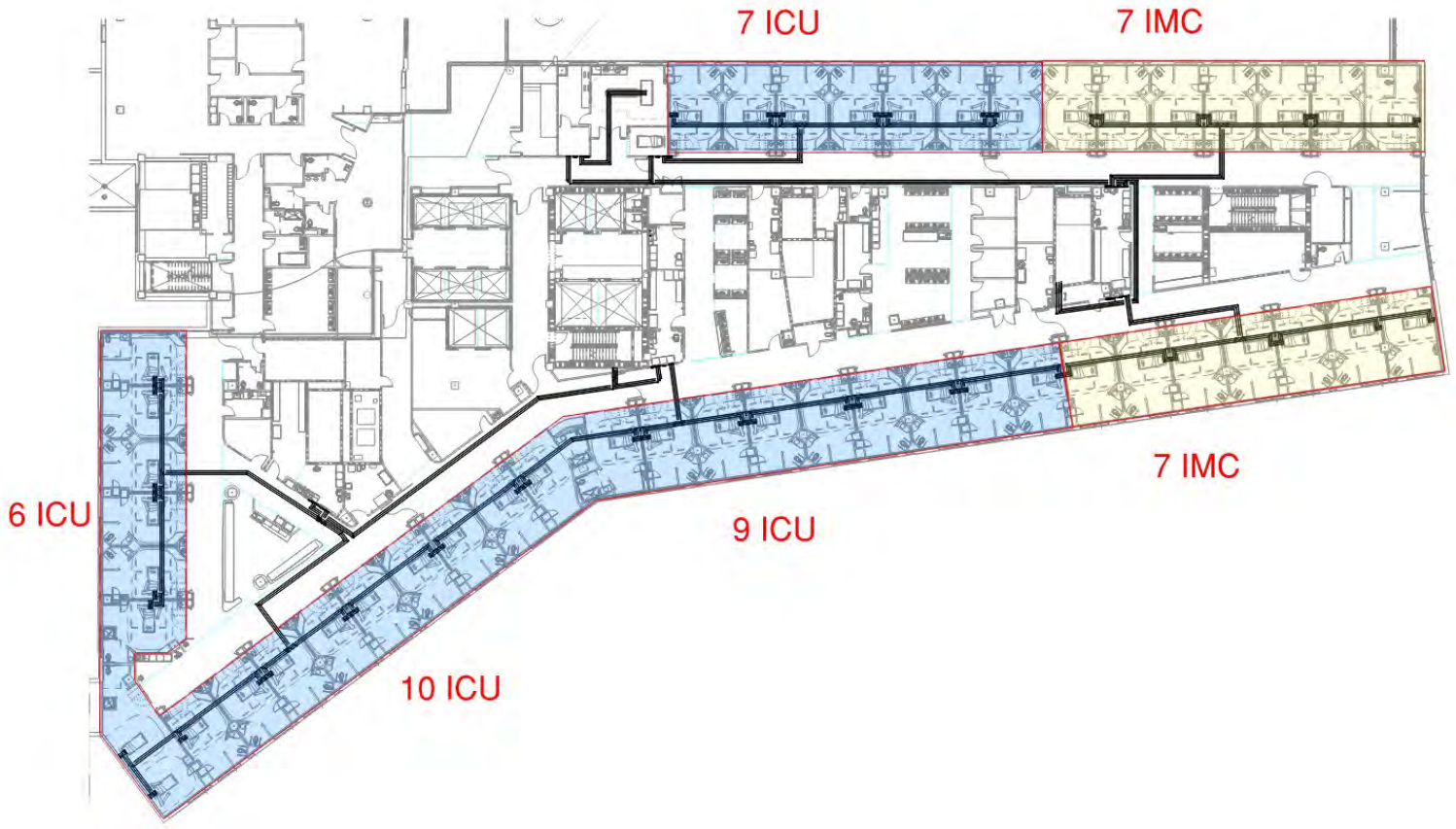
New Master Planning | Summary

- Central Systems set up to accommodate future space usage and pandemic operation mode.
- Floors zoned and valved for ease of room conversion
- 8th Floor piping sized to handle pandemic operation



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What does NFPA says

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NFPA 99 | 2018

5.1.14.7.3

An annual review of bulk system capacity shall be conducted to ensure the source system has sufficient capacity.

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NFPA 99 | 2018

5.1.3.6.3.9 (B)

Medical air compressors shall be sufficient to serve the **peak calculated demand** with the largest single compressor out of service. In no case shall there be fewer than two compressors.

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NFPA 99 | 2018

5.1.3.7.1.1

Medical-surgical vacuum central supply systems shall consist of the following:

(1) Two or more vacuum pumps sufficient to serve the **peak calculated demand** with the largest single vacuum pump out of service.

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NFPA 99 | 2021

5.1.14.1.2.1

The Responsible Facility Authority shall have primary responsibility for implementation of the piped medical gas and vacuum system requirements of this code for the Health Care Facility, including all medical gas, support gas, medical vacuum and WAGD systems.

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NFPA 99 | 2021

5.1.14.1.3.1

The person designated as the Responsible Facility Authority shall be qualified to interpret, implement and advise on this Code

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NFPA 99 | 2024 (proposed)

"The system designer shall size the piping such that the calculated pressure or vacuum losses across the piping as designed do not exceed 10% of the intended operating pressure at the source valve. **The pressure drop calculations shall become part of the facility's permanent records."**

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Conclusion

- Defining Medical Gas Master Planning
  - Existing and New
- Reasons to Master Plan
- Master Planning in Action
- NFPA Requirements

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Questions?

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