

23<sup>RD</sup> ANNUAL



23<sup>RD</sup> LCI CONGRESS  
OCTOBER 19-22

# The Complexities of Production Planning for Pharmaceutical Facilities

Scott Donnelly, Merck

Jeff Beck, Jacobs

Michael Cloud, Jacobs

Mike D'Avanzo, Total Facility Solutions

LEARN BY DOING FROM THOSE WHO DO

OCTOBER 21, 2021



# Health precautions to keep everyone as safe as possible at Congress:

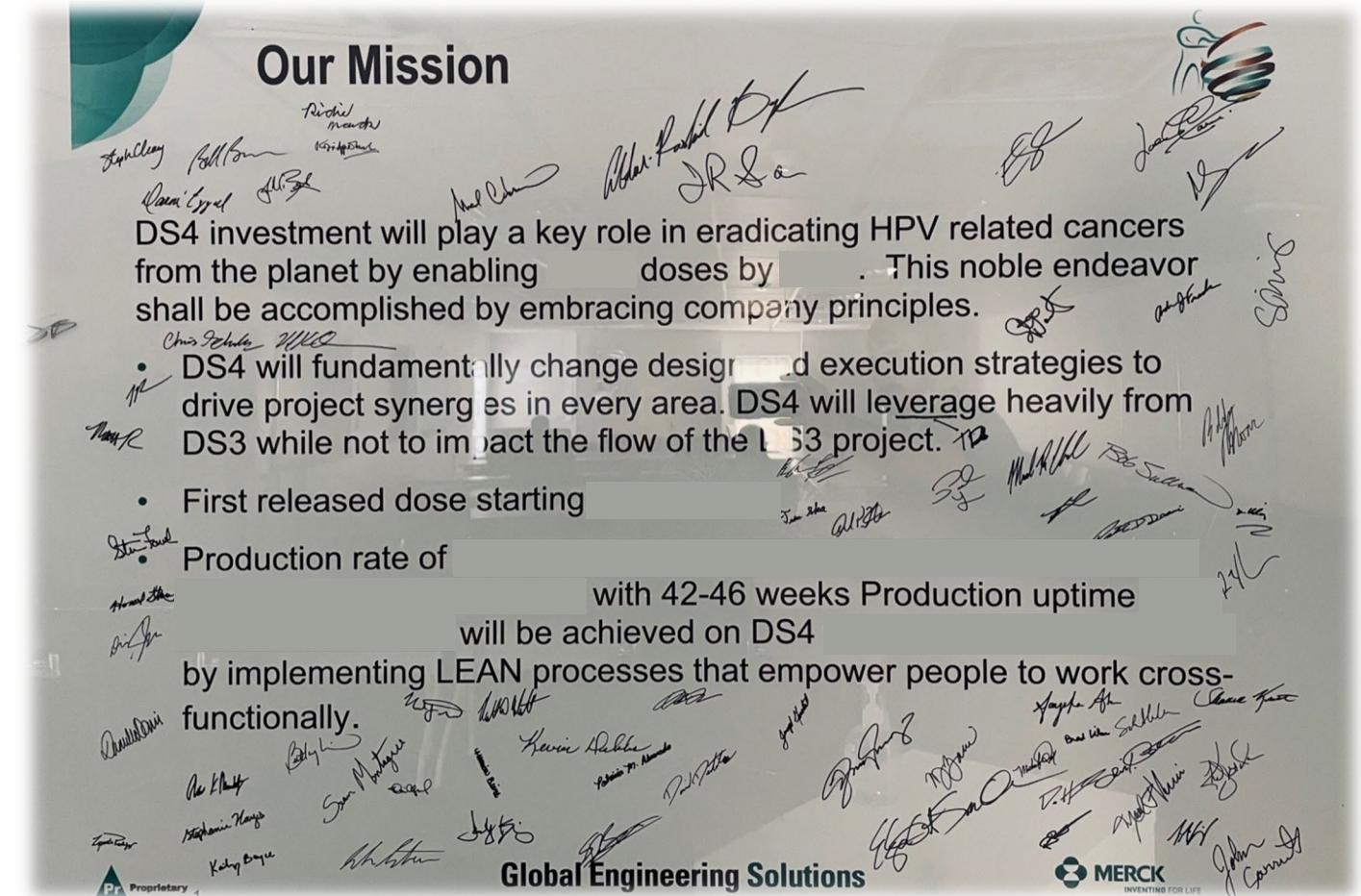
- Wear masks at all times in indoor events.
- Complete your daily health screening on your phone and bring it with you when you enter the center each day.
- Practice social distancing to the extent possible. Seating at plenary sessions is being structured to help with this.
- If you feel ill at any time, please leave the conference and return to your room/consult a physician as necessary.
- Ultimately, our collective health and safety at Congress is up to all of us. Thanks for your support!





# Our Mission

- Eradicating HPV related cancers
- Embracing company principles
- Driving project synergies
- Meeting production rates
- Implementing LEAN processes
- Empowering people





# DS3 Overview

- New 115,000 Sq. Ft. Building
  - (2) Processing Suites
  - (3) Support Suites
  - (1) Sterile Supply Suite
  - (1) Office Suite
- Exterior Substation
- New Modular Chiller Plant
- New Clean Utilities in Existing Building





# DS4 Overview

- New 225,000 Sq. Ft. Building
  - (4) Processing Suites
  - (7) Support Suites
  - (1) Sterile Supply Suite
  - (1) Office Suite
  - New Clean Utilities
- Energy Center Expansion
- Outside Building Limit
  - New HazMat Building
  - Bulk Chemical Tank Farm
  - Wastewater Treatment





# The Problem Statement

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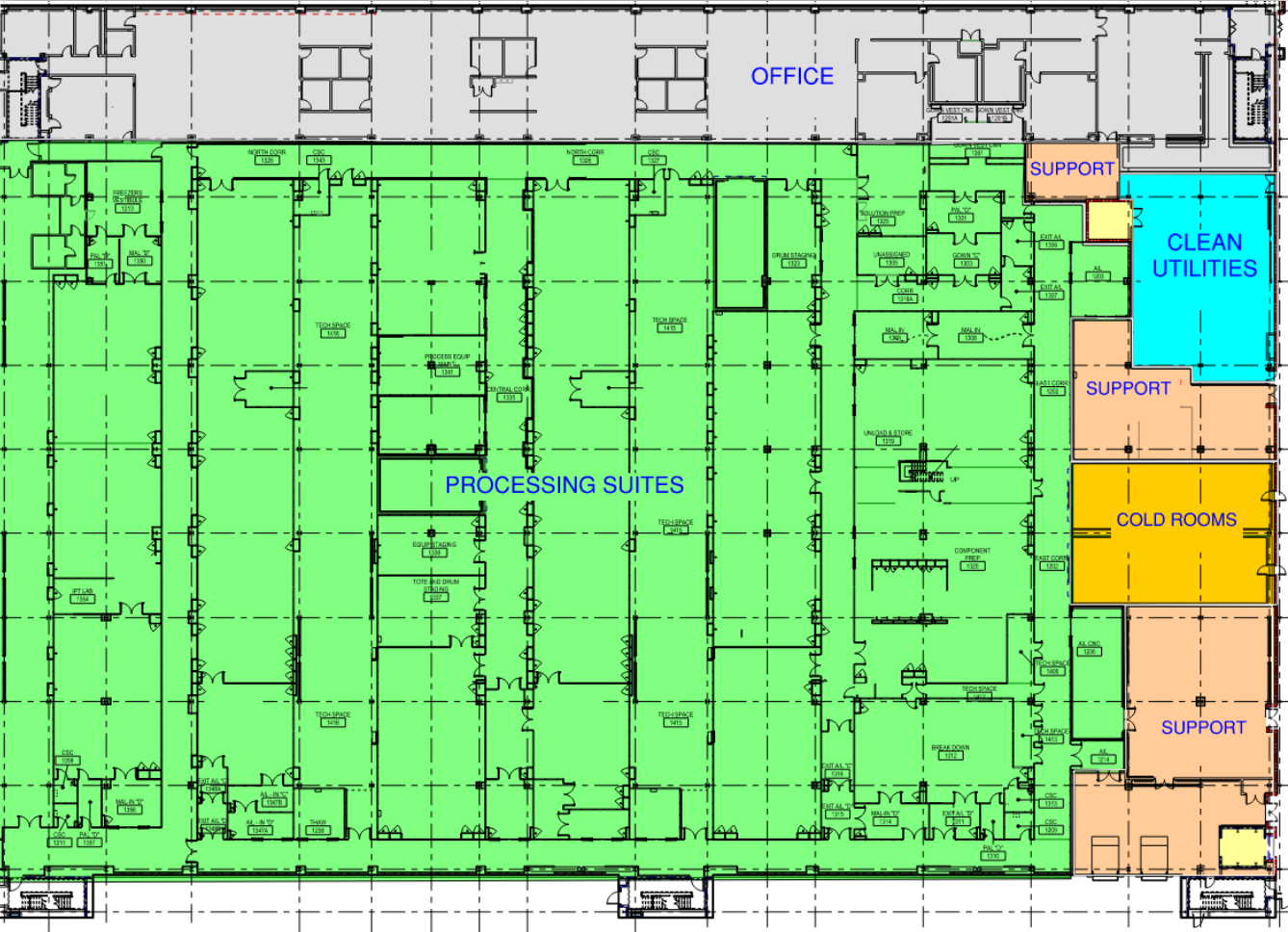
Deliver two vaccine manufacturing facilities  
using lean construction principles.



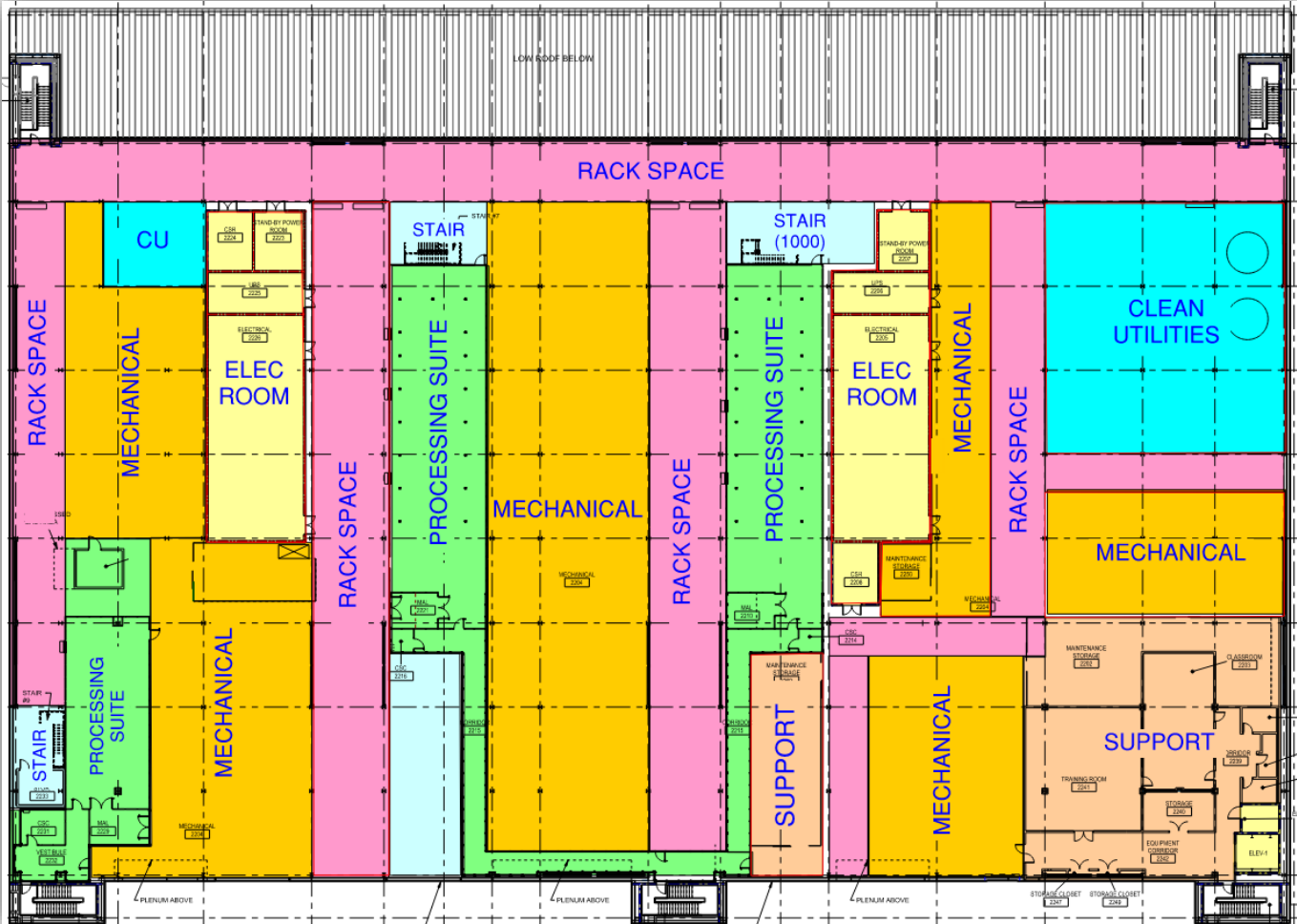
# Approach



# Defining Zones



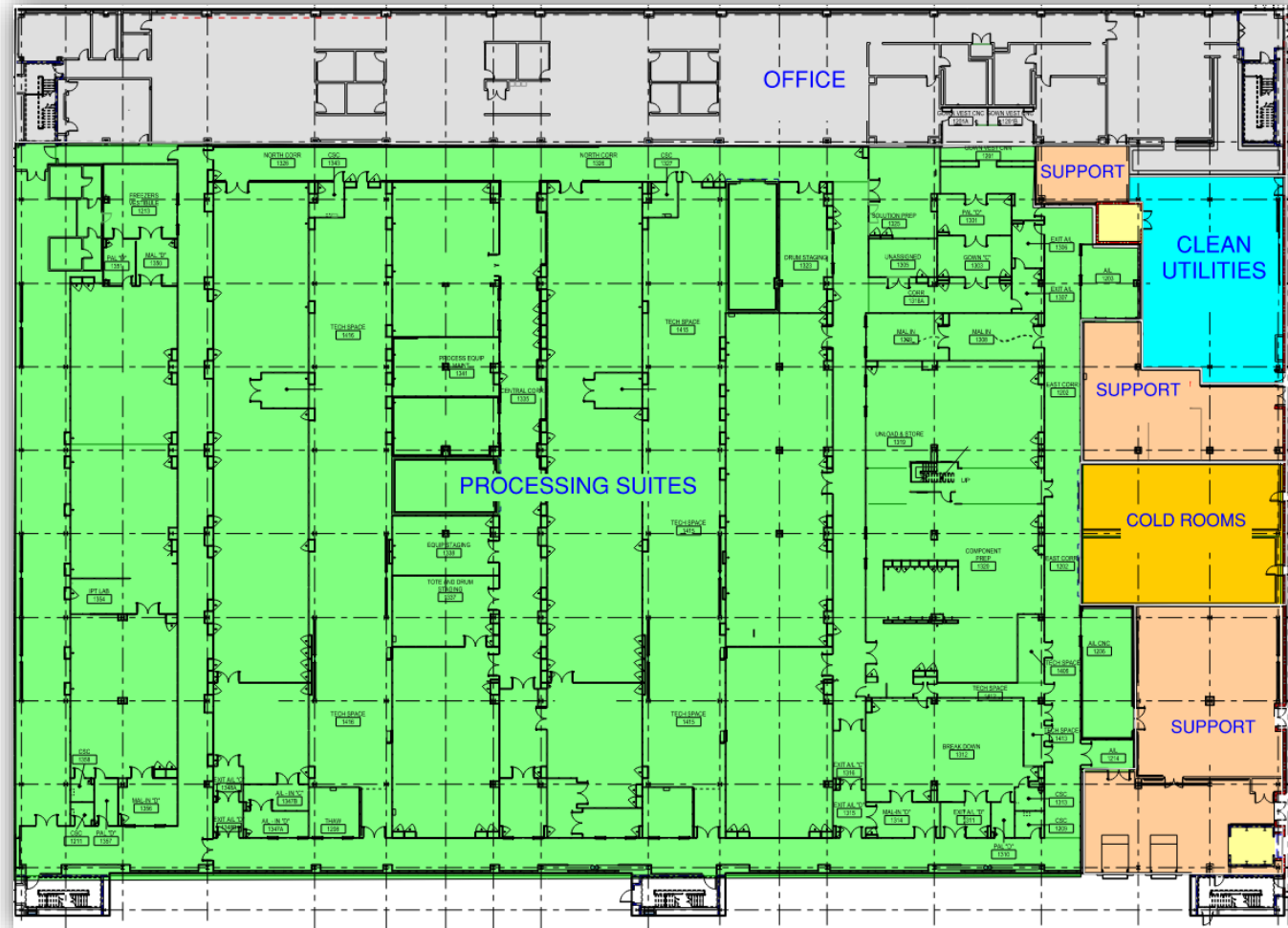
Level 01



Level 02



# Identifying Takt vs. Pull



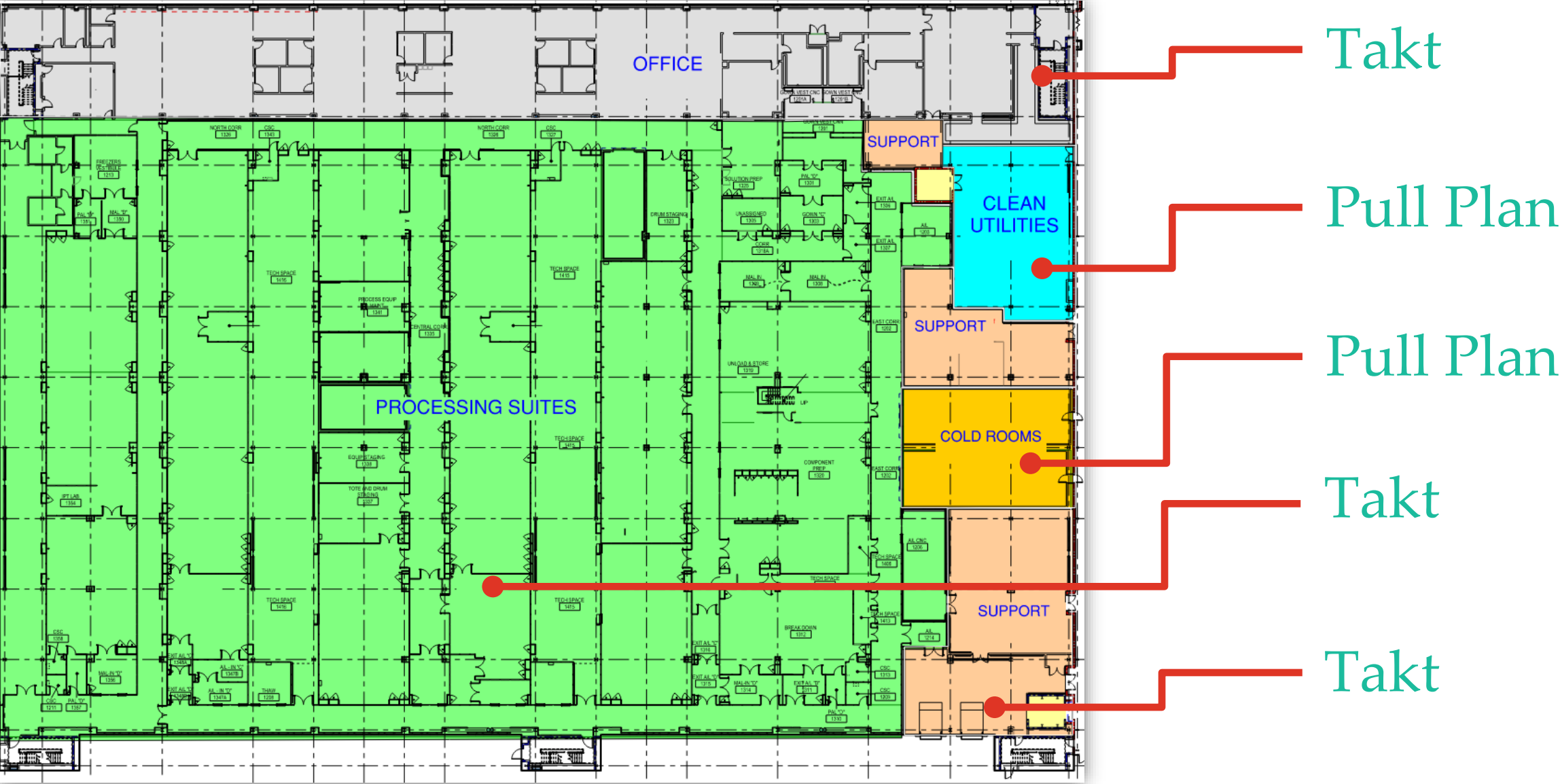
## Pull Planning

- Single zones
- Typically have long working durations

## Takt Planning

- Zones broken down into areas
- Repeatable sequence of work
- Rhythmic (beat) durations

# Identifying Takt vs. Pull



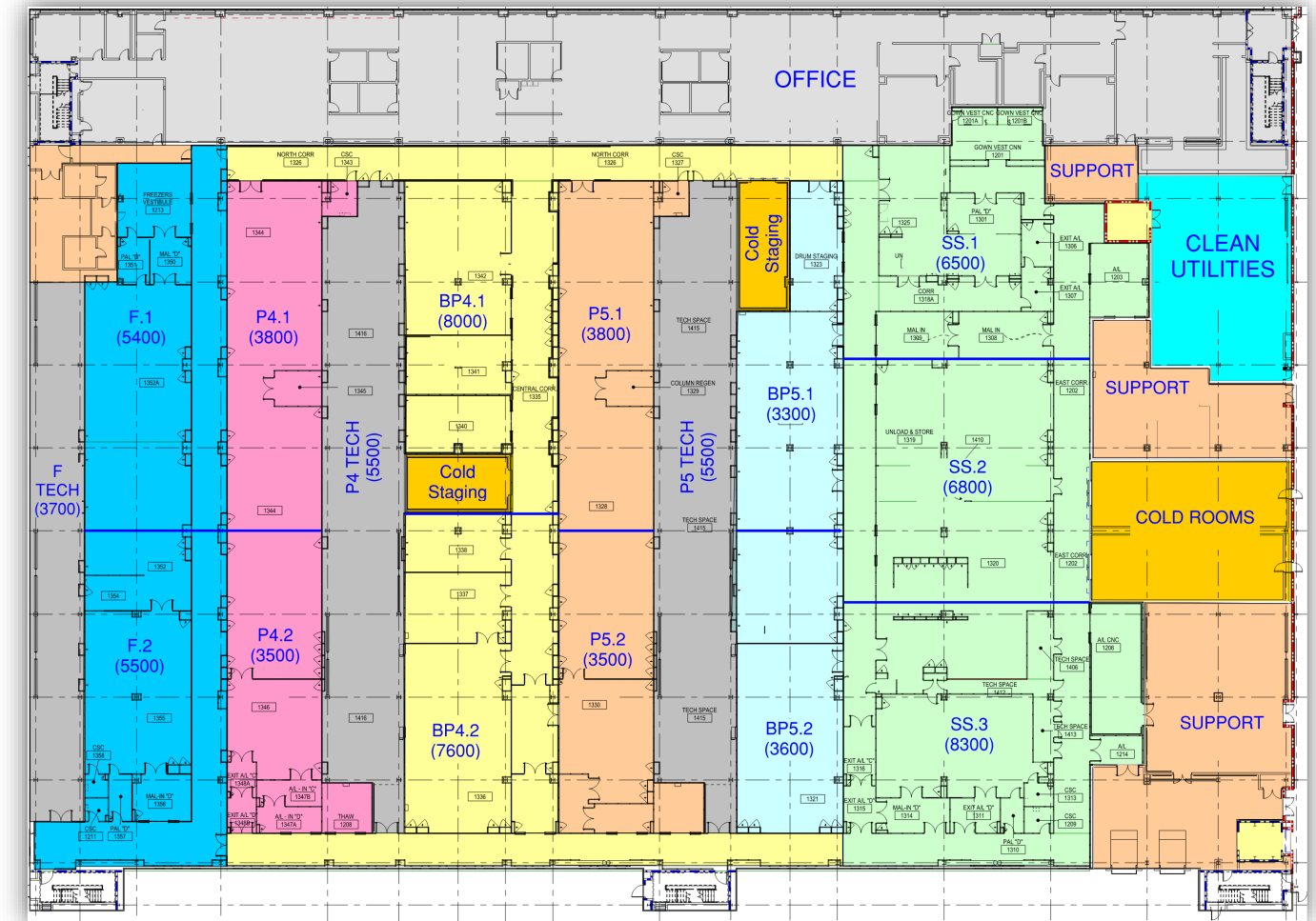


# Defining Areas



# Defining Areas

- Zones are broken into areas
- Areas are sized based on:
  - Amount of work
  - Crew size
  - Block of time (“takt”)
- Trades work area-to-area to the “takt”





# Pull Planning Example



# Pull Planning – Identifying Sequence

Hoist Steel

Overhead Hygienic

Equipment Setting

Supports / Hangers

Overhead Utilities

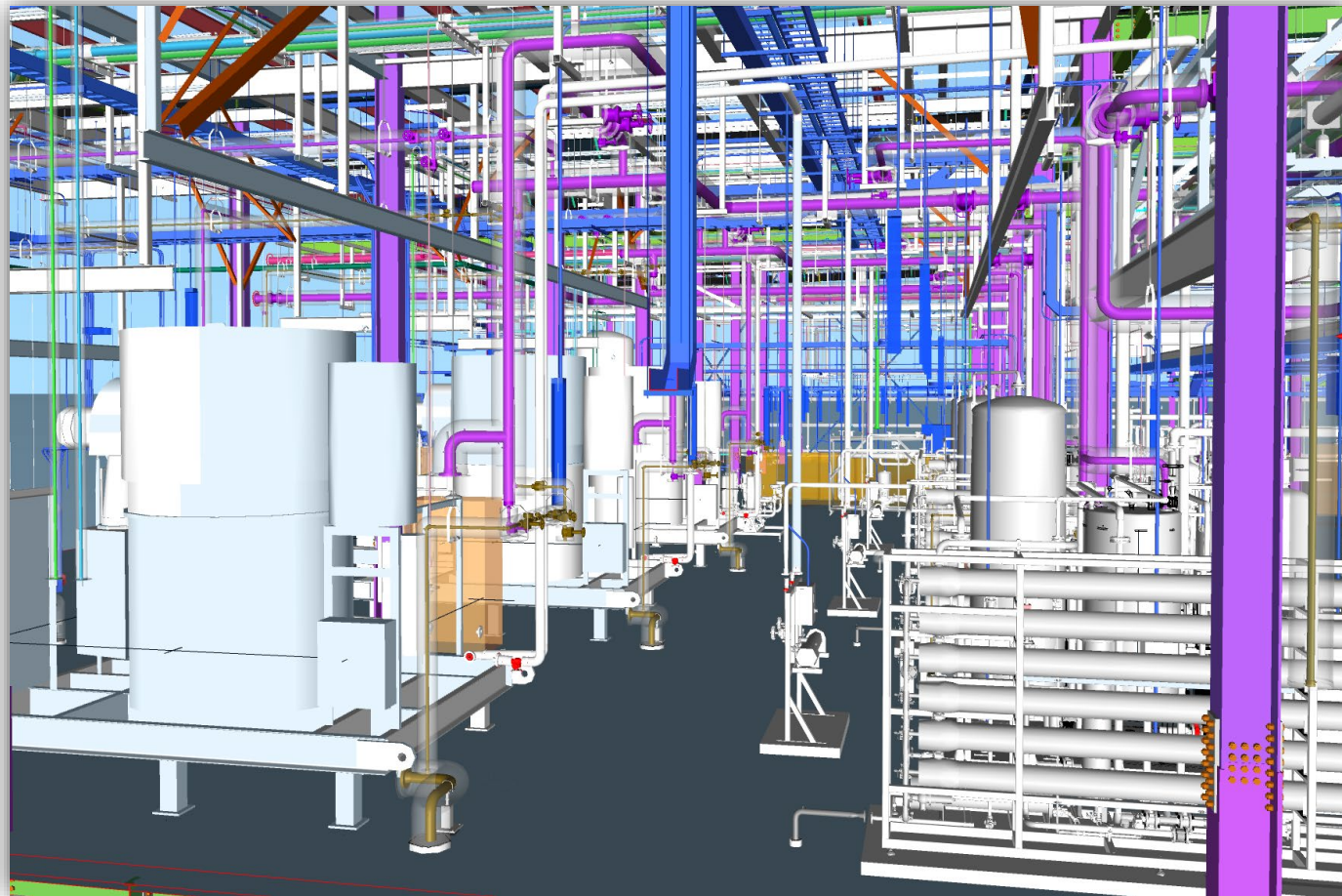
Equipment Tie-ins





# Pull Planning – Applying Durations

<b>LEVEL 2 Clean</b> <b>Utility Area -</b> <b>Phase 1</b> <b>Delivery Train</b> <b>2.5</b> Pull Plan	26' Lvl Steel / Hanger Level	Hangers C		Hangers	Hangers	Hangers	Hangers										
	Off-Rack Rough Level	Pck Pt/Mono	Pck Pt/Mono	OR Rough	OR Rough	OR Rough	OR Rough	OR Rough	OR Rough								
		Hyg Hgrs C	Hyg Hgrs C	Hyg Hgrs	Hyg Hgrs	Hyg Hgrs	Hyg Ppg	Hyg Ppg	Hyg Ppg	Hyg Ppg	Hyg Ppg						
	Set Equipment Level			HK Pads	PreTreatmt	WFI Stills	WFI Stills		WFI HtExchrs						PreTrmt Ppg Complt - 1st 2 WFI Gen Pp		
	Term @ Equip Level										Branch/Hook	Branch/Hook	Branch/Hook	Branch/Hook	Branch/Hook	Branch/Hook	ups
											LV Rack	Low Rack	Low Rack	Elec/LV	Elec/LV	Elec/LV	Elec/LV

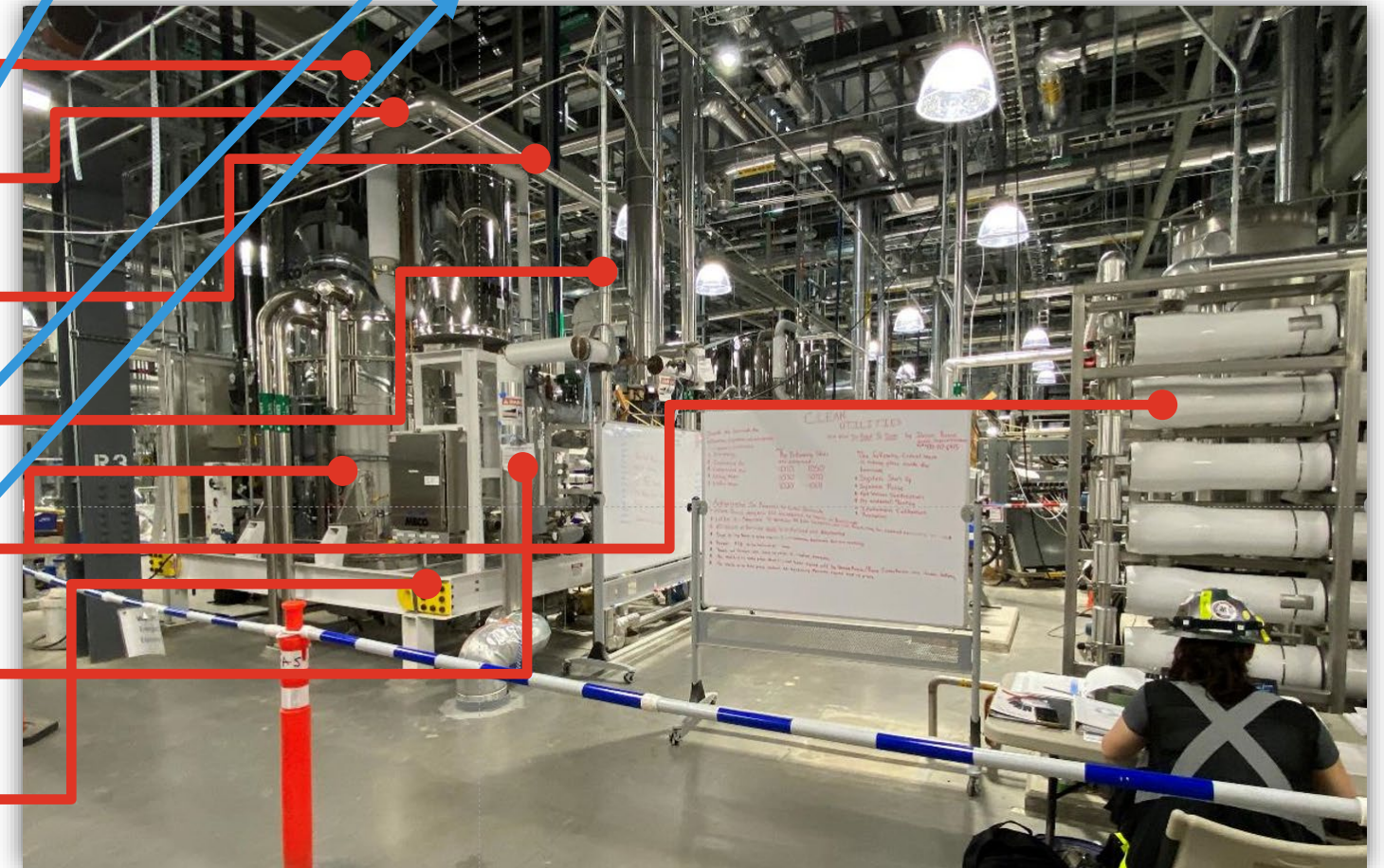




# Pull Planning – Applying Durations

<div>LEVEL 2 Clean</div> <div>Utility Area -</div> <div>Phase 1</div> <div>Delivery Train</div> <div>2.5</div> <div>Pull Plan</div>	26' Lvl Steel / Hanger Level	Hangers C		Hangers	Hangers	Hangers	Hangers											
	Off-Rack Rough Level	Pck Pt/Mono	Pck Pt/Mono	OR Rough	OR Rough	OR Rough	OR Rough	OR Rough	OR Rough									
		Hyg Hgr C	Hyg Hgrs C	Hyg Hgrs	Hyg Hgrs	Hyg Hgrs	Hyg Ppg	Hyg Ppg	Hyg Ppg	Hyg Ppg	Hyg Ppg							
	Set Equipment Level			Ht Exch Pads	PreTreatmt	WFI Stills	WFI Stills		WFI HtExchrs								PreTrmt Ppg Complt - 1st 2 WFI Gen Pp	
	Term @ Equip Level										Branch/Hook	Branch/Hook	Branch/Hook	Branch/Hook	Branch/Hook	Branch/Hook	Branch/Hook	
												Drop / Tie	Drop / Tie	Drop / Tie	Drop / Tie	Drop / Tie	Drop / Tie	Drop / Tie
											LV Rack	Low Rack	Low Rack	Elec/LV	Elec/LV	Elec/LV	Elec/LV	

Pick Point Steel  
Supports / Hangers  
Overhead Rough  
Overhead Hygienic  
Equipment Setting  
Equipment Tie-ins  
Electrical / Low Voltage





# Takt Planning Example



# Takt Planning – Processing Suites

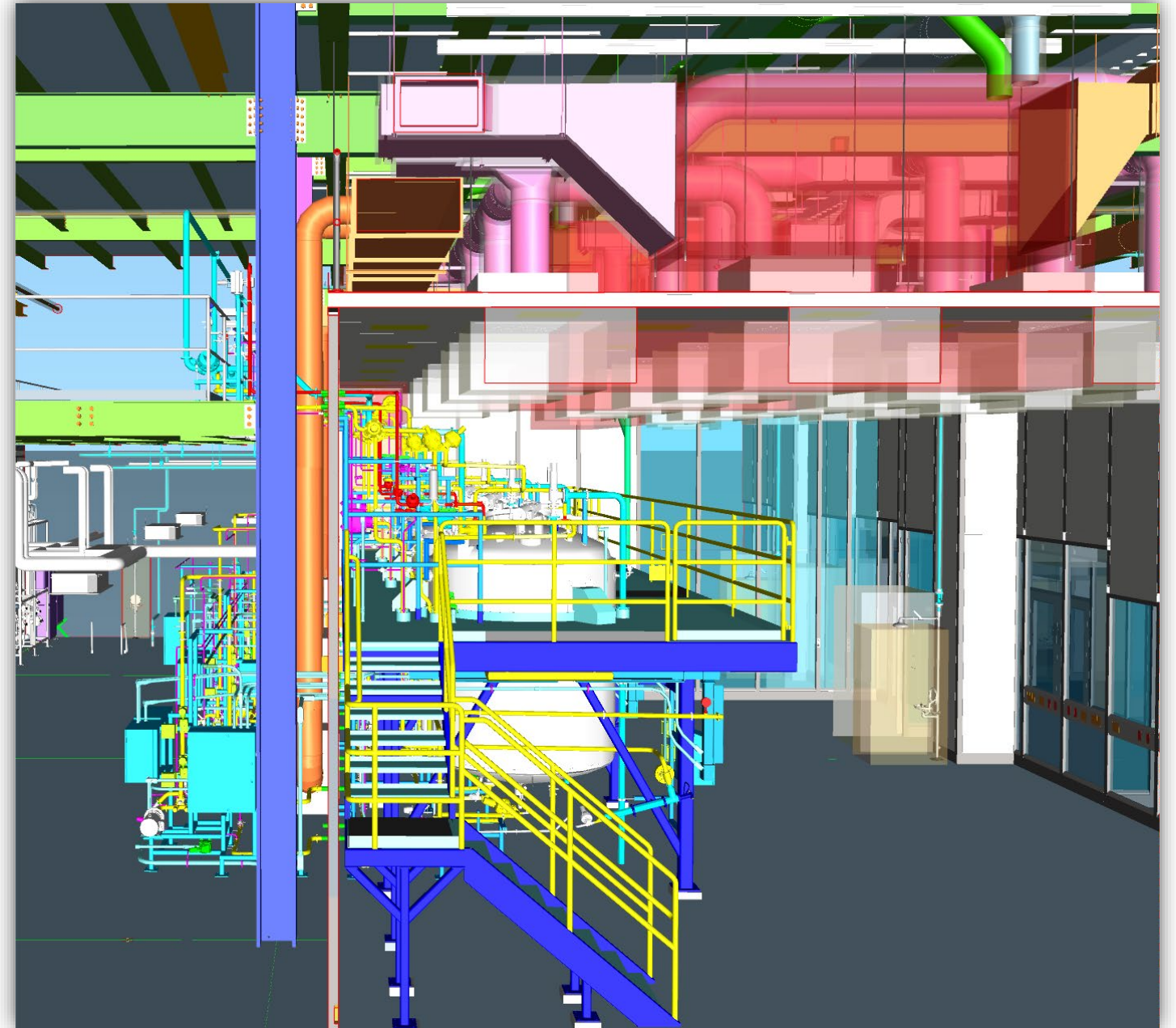
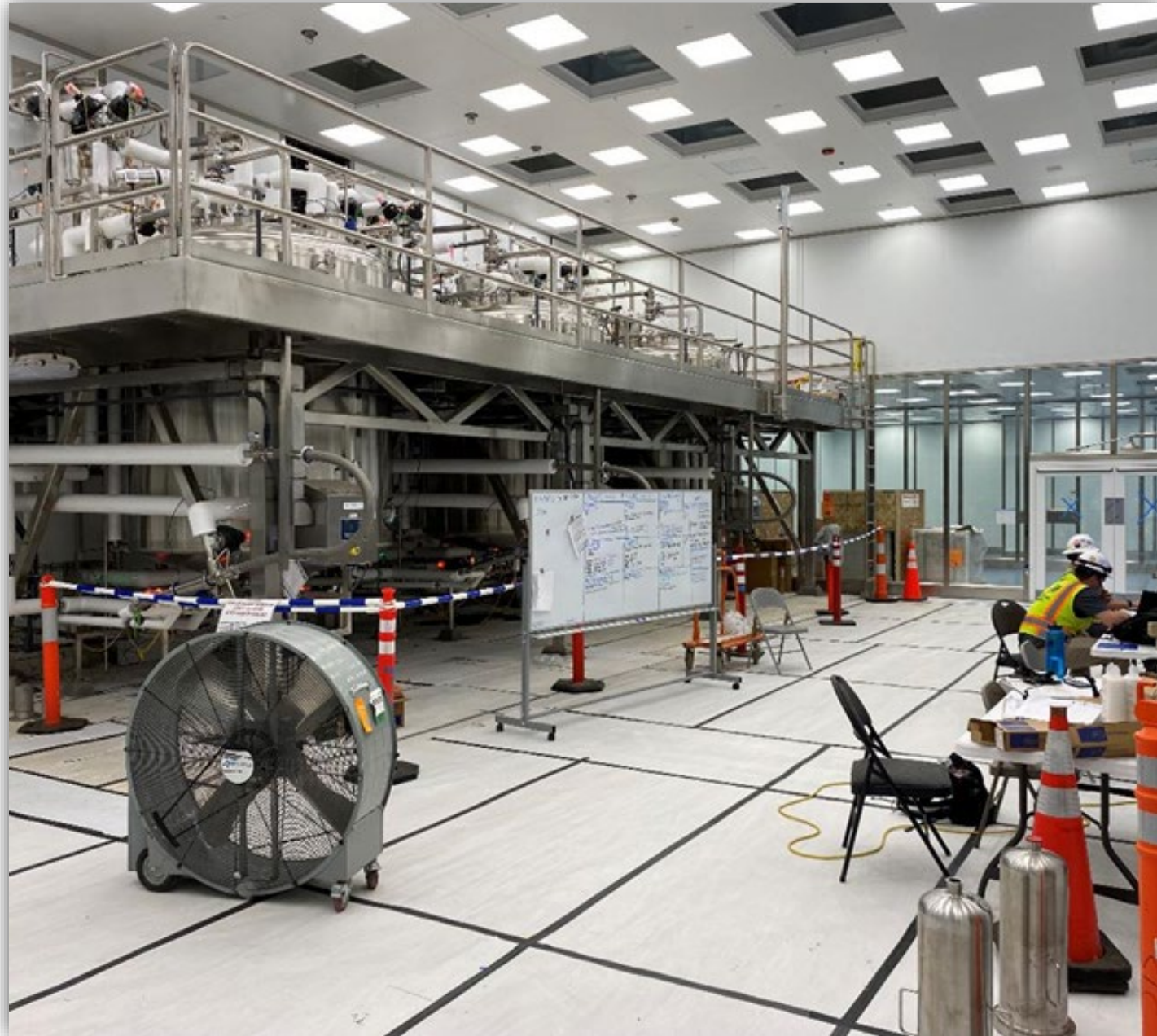
## Established (3) phases for processing suites

- Interstitial Phase
  - Clean room MEP systems
  - Walkable ceiling system
- Suite Phase
  - Flooring prep & finish
  - Wall track, panels, in-wall devices
- Equipment Fit-out Phase
  - Setting process skid equipment
  - Clean & tech side connections





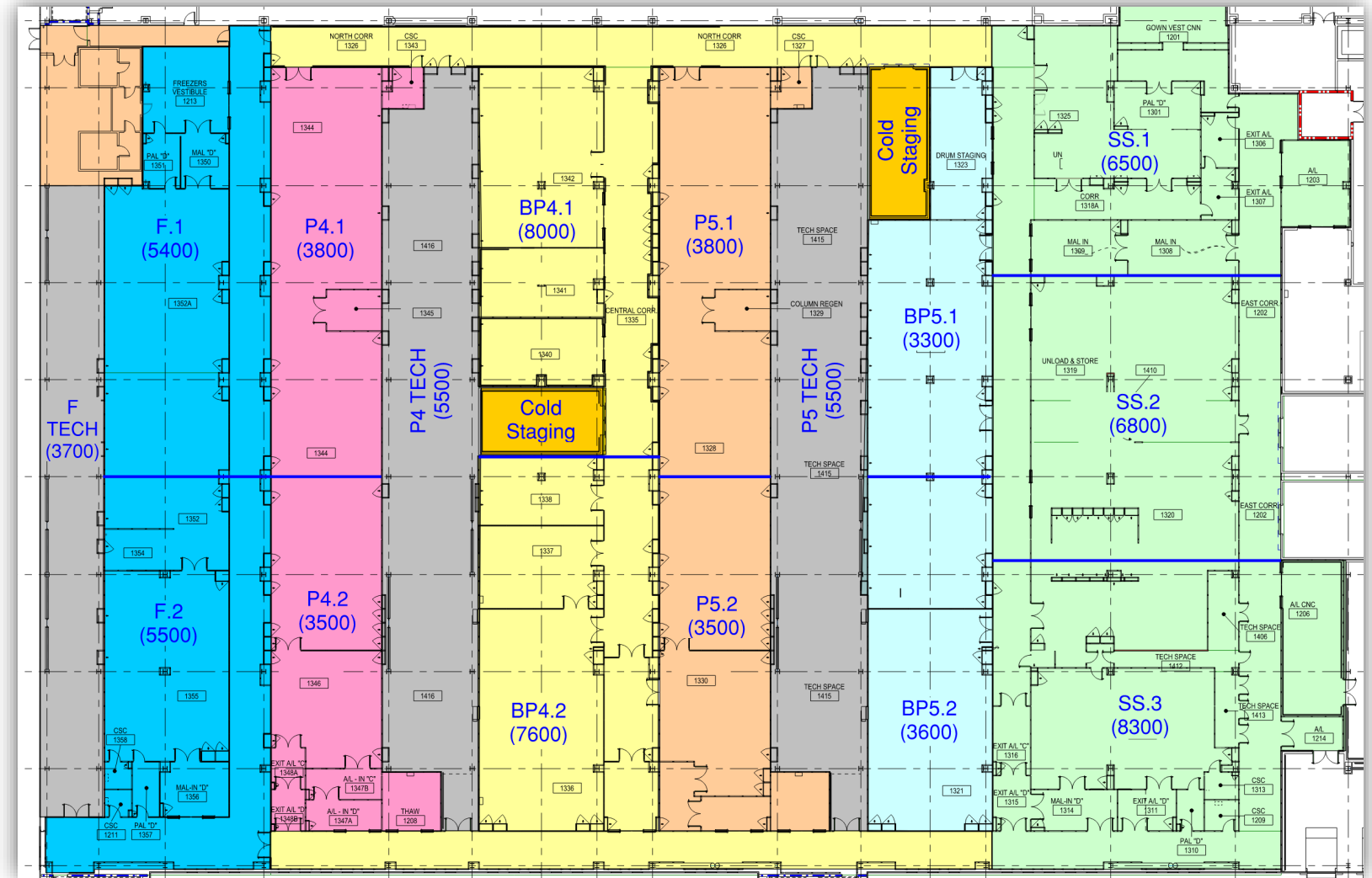
# Takt Planning – Processing Suites



# Takt Planning – Determining Area Sizes

## Determine Area Sizes

- Width determined by suite
- Tech space driven by:
  - Number of pipe racks
  - Equipment operations
- Clean space sizes driven by:
  - Quantity of work (all trades)
  - Number of workers
  - Square footage





# Takt Planning – Interstitial Phase

- Release Point = High Bay Zone
- *Goal = Install Flooring*
- Factors:
  - Amount of Ductwork
  - # of Clean Room Fan Coil Units
  - Ceiling Area (Number of Grids)

Interstitial Phase	P4.1. - North HB MEP 12	CRFCUS (5)	Spider Duct	Spider Duct	C grid	C grid	C railing	C railing			Final Duct			FP Holes	FP Heads	BAS Cabling	BAS Cabling				
			CW Connect	CW Connections		Light Inst	Light Inst	C panels		C panels				IA to Doors							
			FA Conduit	Ceiling Hang		Drop to LTG	Drop to LTG	Drops to BR		VDS Drops											
			FP Drops	FP Drops																	
		Install LTG	BR/LTG HR	VDS Conduit	LV Conduit Br											VDS Terms	Terms				
			D Mn Duct o	CRFCUS (7)	Spider Duct	Spider Duct	C grid	C grid		C railing	C railing				FP Heads	IA to Doors		BAS Cabling	BAS Cabling		
						Ceiling Hangers				BAS Panel											
				FA Conduit	CW Connect	CW Connect	Light Inst	Light Inst		C panels	C panels			FP Holes			VDS Terms	Terms	LV Pulls		
	P4.2. - South HB MEP 13			FP Drops	FP Drops	Drop to LTG	Drop to LTG	Drop to LTG		Drops to BR				Final Duct							
		BR/LTG Con	Install LTG	BR/LTG HR	VDS Conduit	LV Conduit Br				VDS Drops											
	BP4.1. - North HB MEP 10					CRFCUS (9)	Spider Duct	Spider Duct & Insul		C grid	C grid	C railing		C railing	Final Duct		FP Holes		BAS Cabling	BAS Cabling	
							CW Connect	CW Connections		Light Inst	Light Inst	C panels		C panels			IA to Doors	FP Heads			
										Drop to LTG	Drop to LTG	Drops to BR					VDS Terms	Terms	LV Pulls	LV Devices	Devices
		LTG Hangers	BR/LTG Con	Install LTG	BR/LTG HR	FA Conduit	FP Drops	FP Drops													
	BP4.2. - South HB MEP 10																				
										Spider Duct	Spider Duct	C grid		C grid	C railing	C railing	Final Duct		FP Holes	Terms	BAS Cabling
										CW Connect	CW Connect	Light Inst		Light Inst	C panels	C panels			IA to Doors	FP Heads	
			LTG Hangers	BR/LTG Con	Install LTG	BR/LTG HR	FA Conduit			FP Drops	FP Drops	Drop to LTG		Drop to LTG	Drops to BR						
															VDS Pull		VDS Drops		VDS Terms	LV Pulls	LV Devices

# Takt Planning – Suite Phase

- Release Point = Floor Completion
- Factors:
  - Wall Track and Columns
  - In-Wall Rough & Devices
  - Equipment & Wall Panel Setting
- *Goal = Process Equipment Set*

Suite Phase	P4.1.Suite - North	Floor Prep	Floor		Wall Tracks	Wall Column	Walls	Doors	Return Air Sh	Door Auto			Sealants		
					Equip	Equip	Equip		Door Auto						
							InWall R	VDS InWall	InWall Insp	Devices	LV Devices		SEC Terms		
	P4.2.Suite - South	Floor Prep	Floor				Wall Tracks	Wall Column	Walls	Doors	Return Air Sh	Door Auto		Sealants	
							Equip	Equip	Equip		Door Auto				
								InWall R	VDS InWall	InWall Insp	Devices	LV Devices		SEC Terms	
	BP4.1.Suite - North					Floor Prep	Floor	Wall Tracks	Wall Column	Walls	Doors	Return Air Sh	Door Auto		
								Equip	Equip	Equip		Door Auto		Sealants	
									InWall R	VDS InWall	InWall Insp	Devices	LV Devices	SEC Terms	
	BP4.2.Suite - South							Floor Prep	Floor	Wall Tracks	Wall Column	Walls	Doors	Return Air Sh	Door Auto
										Equip	Equip	Equip		Door Auto	Sealants
											InWall R	VDS InWall	InWall Insp	Devices	LV Devices



# Takt Planning – Equipment Fit-Out Phase

- Release Point = Equipment Setting
- *Goal = System Completion*
- Factors:
  - Quantity of Hygienic and Utility Piping
  - Quantity of Electrical Power Wiring
  - Quantity of Low Voltage Wiring

Process Equipment Fitout Phase	P4 Suite	Equip	TSS BAP	CS Uconn	CS Uconn	SS Conn's	SS Conn's	SS Conn's	EL		LV Wire	Insulate	Insulate	Pre-Energ.	Pre-Energ.	Pre-Start		
		Equip	CSS BAP	CSS BAP	INSTALL	Grnd/Recpt	LV	Low FP	Low FP	Low FP								
		Equip	TSS UF	CS Uconn	CS Uconn	SS Conn's	SS Conn's	SS Conn's	EL	LV Wire	Insulate	Insulate	Pre-Energ.	Pre-Energ.	Pre-Start			
		Equip	CSS UF	CSS UF	CS UF	INSTALL	INSTALL	Low FP	Low FP	Low FP	Grnd/Recpt	LV						
		Equip	TSS RG	CS Uconn	CS Uconn	SS Conn's	SS Conn's	SS Conn's	EL	LV Wire	Insulate	Insulate	Pre-Energ.	Pre-Energ.	Pre-Start			
		Equip	CSS RG	CSS RG	CS RG	INSTALL	Grnd/Recpt	LV	Low FP	Low FP	Low FP							
				Equip	TSS Chr 1	CS Uconn	CS Uconn	SS Conn's	SS Conn's	SS Conn's	EL	LV Wire	Insulate	Insulate	Pre-Energ.	Pre-Energ.	Pre-Start	
				Equip	CSS RG	CSS RG	CS CHR1	INSTALL	Grnd/Recpt	LV	Low FP	Low FP	Low FP					
					Equip	TSS HA FD	CS Uconn	CS Uconn	SS Conn's	SS Conn's	SS Conn's	EL	LV Wire	Insulate	Insulate	Pre-Energ.	Pre-Energ.	
					Equip	CSS HA FD	CSS HA FD	CS HA FD	INSTALL	Grnd/Recpt	LV			Low FP	Low FP	Low FP		
						Equip	TSS Chr 2	CS Uconn	CS Uconn	SS Conn's	SS Conn's	SS Conn's	EL	LV Wire	Insulate	Insulate	Pre-Energ.	
						Equip	CSS CHR2	CSS CHR2	CS CHR2	INSTALL	Grnd/Recpt	LV				Low FP	Low FP	Low FP
							Equip	TSS MF	CS Uconn	CS Uconn	SS Conn's	SS Conn's	SS Conn's	EL	LV Wire	Insulate	Insulate	
							Equip	CSS MF	CSS MF	CSS MF	INSTALL	INSTALL	INSTALL	Grnd/Recpt	LV			Low FP
								Equip	TSS HMG	CS Uconn	CS Uconn	SS Conn's	SS Conn's	SS Conn's	EL	LV Wire	Insulate	
								Equip	CSS HMG	CSS HMG	CS HMG	As. HMG	As. HMG	As. HMG	Grnd/Recpt	LV		Low FP
	P4 BP				Equip	Equip	Equip	Equip	Equip	TSS BP	CS Uconn	CS Uconn	SS conn	Ssconn	Ssconn	EL	LV Wire	Devices
					Equip	Equip	Equip	Equip	Equip		CSS BP	CSS BP	CSS BP	Install	Install	Install	Install	Install

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# Execution by Trade Partner







# Implement Production Plan

- Step 3:
  - Assemble weekly work packages
  - Distribute package to each crew
- Step 4:
  - Weekly reporting
  - Isometrics installed
  - Earned Value (EV) = Spent vs. Earned
  - Percent Planned Completed (PPC)

	ISO Installation	
	Stage Material	Move Material into the Work Area
	Install SS Tubing	Install in Hangers Cut & Face Tubing (as needed) Purge w/ Argon gas Orbital Welding
	Isometrics Drawings	Planned Welds
1	3.00-PA-1505008-SP117S-N-04	1
2	3.00-PA-1505008-SP117S-N-05	1
3	3.00-PA-1505008-SP117S-N-06	1
4	3.00-PA-1505008-SP117S-N-07	4
	Manpower	
	Welders	
	Fitters	
	Spotter	
	Fire Watch	
	Equipment	Scissor Lifts, Argon Dewars, Orbital Welding Equipment, Gang Boxes, Jack Stands
	Notes	Testing, Passivation, Insulation, and Labeling are not included.

ISOs											
#	ISO No.	Welds				Task Completed			Earned Hours	Variances	
		Total	Done	Planned	Balance	Pipe Lay-in	Welding	Total		Key	Description
1	3.00-PA-1505008-SP117S-N-04	1		1	0	13	14	26	0		
2	3.00-PA-1505008-SP117S-N-05	1		1	0	13	14	26	0		
3	3.00-PA-1505008-SP117S-N-06	1		1	0	13	14	26	0		
4	3.00-PA-1505008-SP117S-N-07	4		4	0	31	35	66	0		
Total		7	0	7	0	69	76	145	0		
Backlog											
1					0			0	0		
2					0			0	0		
3					0			0	0		
4					0			0	0		
5					0			0	0		

Crew Size				0
#	Type	Name	Hours Burned	
1				
2				
3				
4				
5				
6				
7				
8				

Variance Key	
1	Materials
2	Manpower
3	Equipment
4	Predecessor
5	Weather
6	Safety
7	Inaccurate Time Estimate
8	Work Area Congestion
9	RFI- Design
10	Customer Change Order

Total Budgeted Hours	145		
Total Earned Hours	0	% Complete	0 %
Total Burned Hours	0	% Efficiency	



# Successes & Learnings



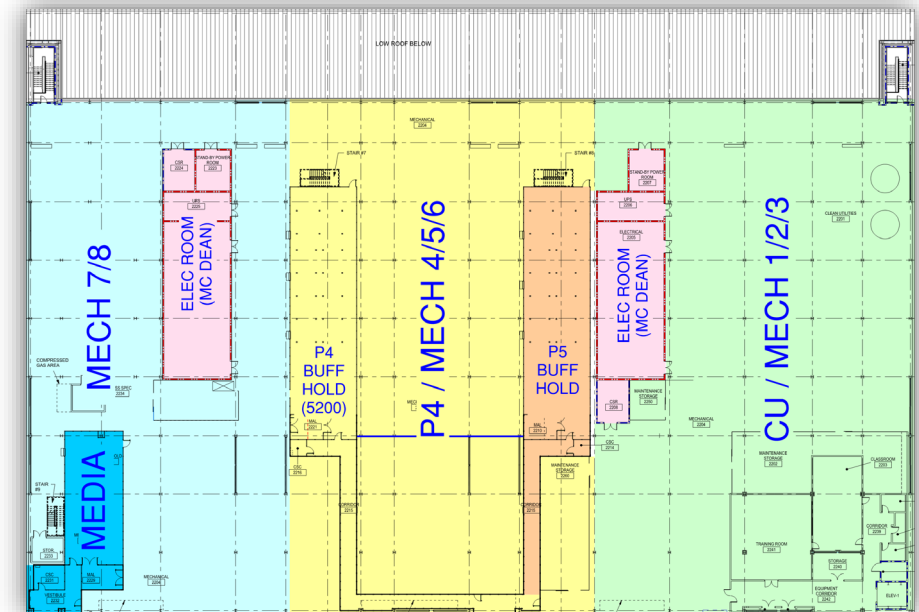
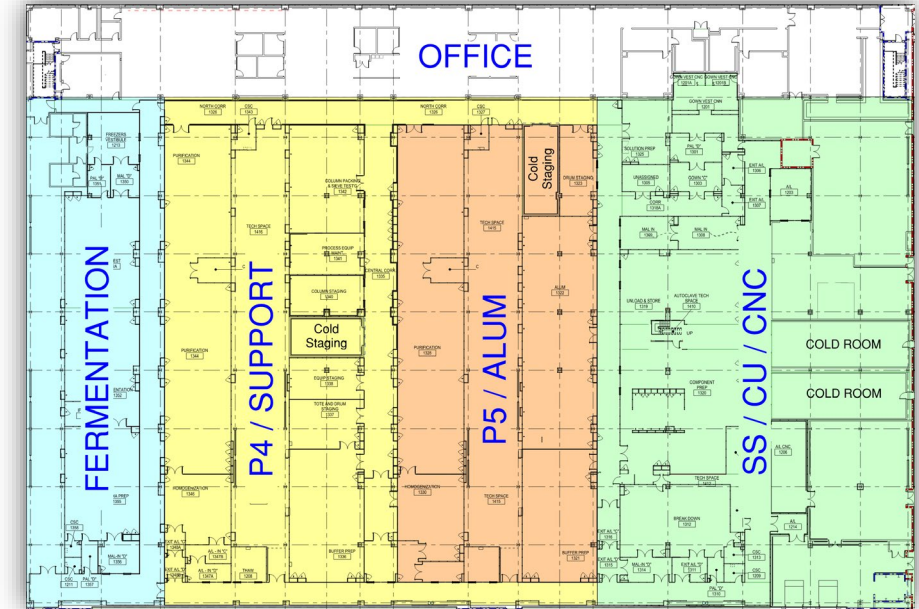


# Learnings

- Collaboration is KEY

# Learnings

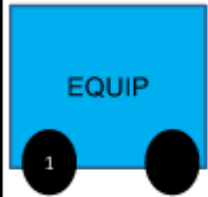
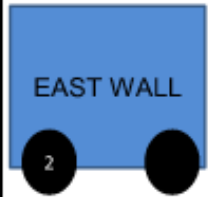
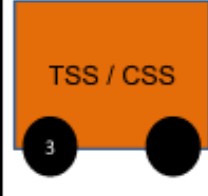
- When developing production strategy:
  - Create initial strategy in BOD
  - Refine in early detail design
- Release designs in same logic as plan
- Release work after strategy is finalized
- Reorganized CM Team
  - Superintendents -> Train Leaders
  - Train Leaders -> Construction Managers
- Added Trains/Phases as needed





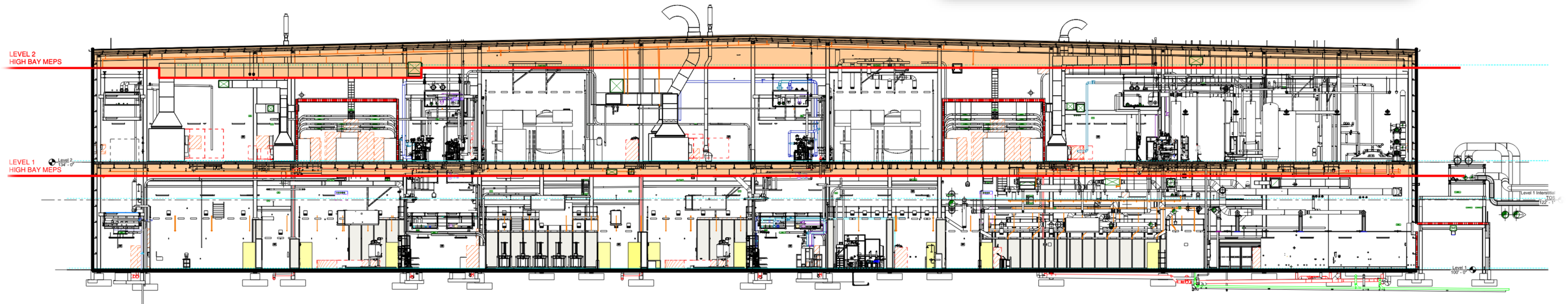
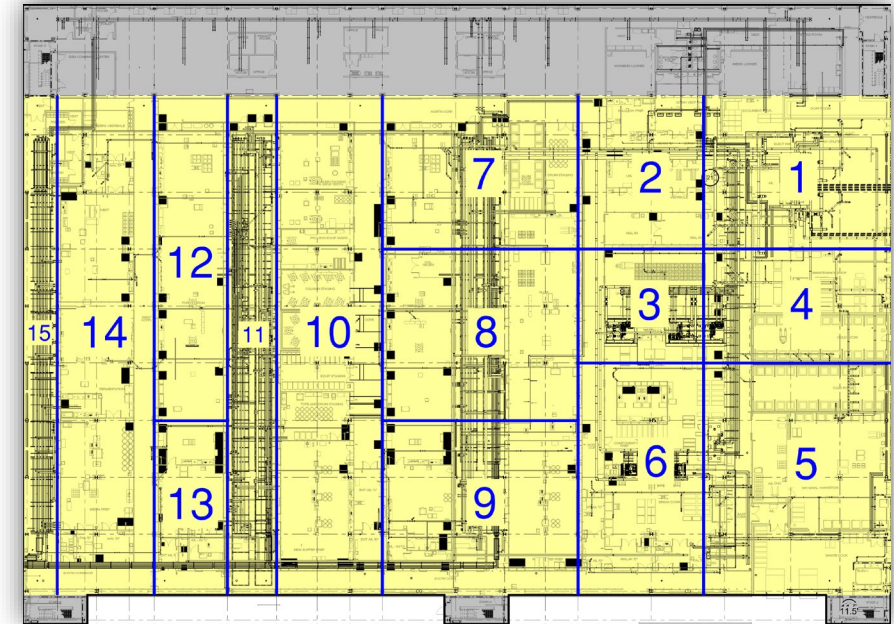
# Learnings

- Boxcar Descriptions
  - Develop with sequence of work
  - Understand each boxcar's scope
  - Develop boxcar hand off descriptions
  - Resource loading boxcar
  - Effected areas and crew size
- Data (quantities) are essential
- Do not deviate from your sequence

TAKT PLAN HAND OFF DESCRIPTIONS		
Takt / Week	Company	Activity
	SIC / Techniserv	Equipment Setting - with Techniserv guidance
	Activities:	Move Equipment from warehouse
		Rig safely into building - from west side of B150 into P4 space, then north into location
		Unwrap and receipt inspection
		Set onto coordinates in final location
		Set Tech Space side equipment first, aligning piping panel with Daldrop wall
		Then set clean side equipment
		Assemble platforms and Structure
		Complete all required documentation, CCRs, test forms, etc.
		Clean area and remove all tools, equipment and debris for next trade
	Crew Size:	
	NOTES	
	Daldrop	Daldrop East Wall
	Activities:	install ceiling track
		install floor track - take some parts out where equipment has to pass
		bring equipment in place by others
		reinstall floor track
		install wall panels around the equipment + parts of caulking which is later not more available
		install cleanroom equipment by others
		finish wall installation
		caulking
		cleaning
	Crew Size:	
	NOTES	
	SIC / Techniserv	Tech Space Side Assembly / Clean Space Side Assembly - with Techniserv guidance
	Activities:	Move Equipment and loose/site assembly pieces from warehouse
		Assemble Misc Loose Pieces
		Assemble all clamped piping
		Complete all required documentation, CCRs, test forms, etc.
		Clean area and remove all tools, equipment and debris for next trade
	Crew Size:	
	NOTES	

# Successes

- High Bay Zone
  - Key component to production strategy
  - Represents MEP work accessed by lifts
  - Critical to releasing the suite phase
  - Turned into a quasi takt and pull plan



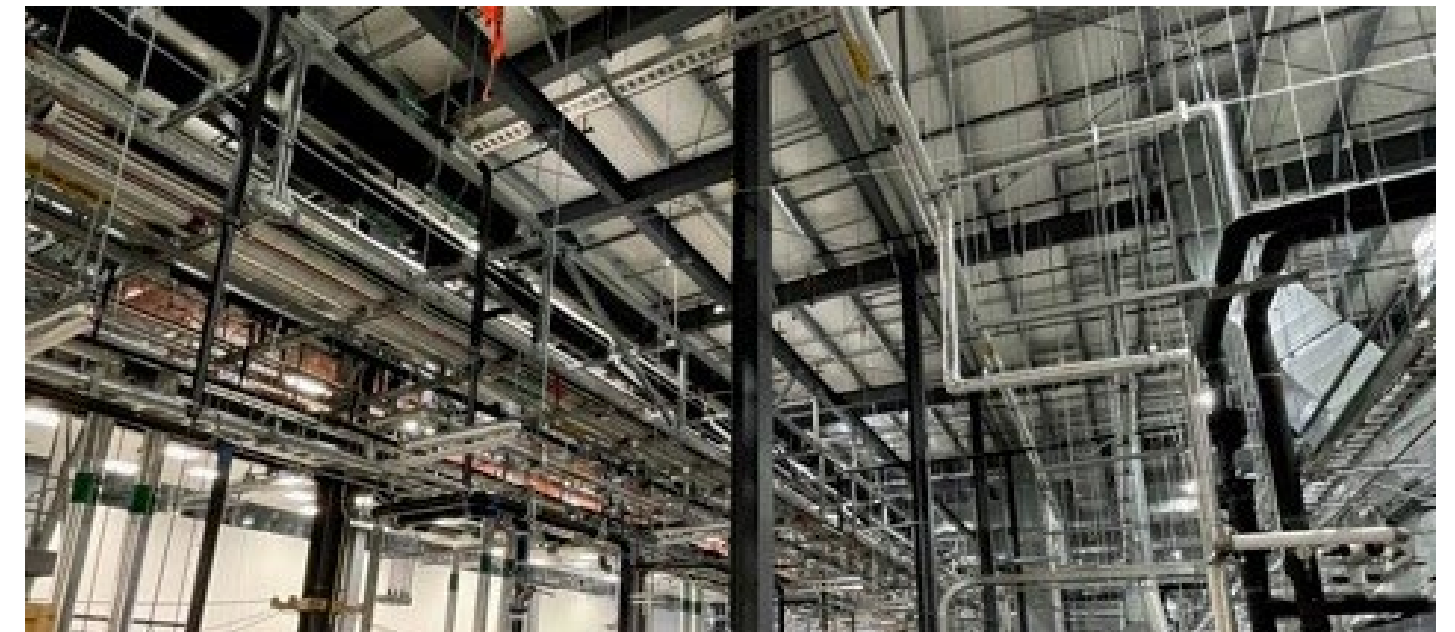


# Successes

- Safety Performance
  - Best planned projects are safest

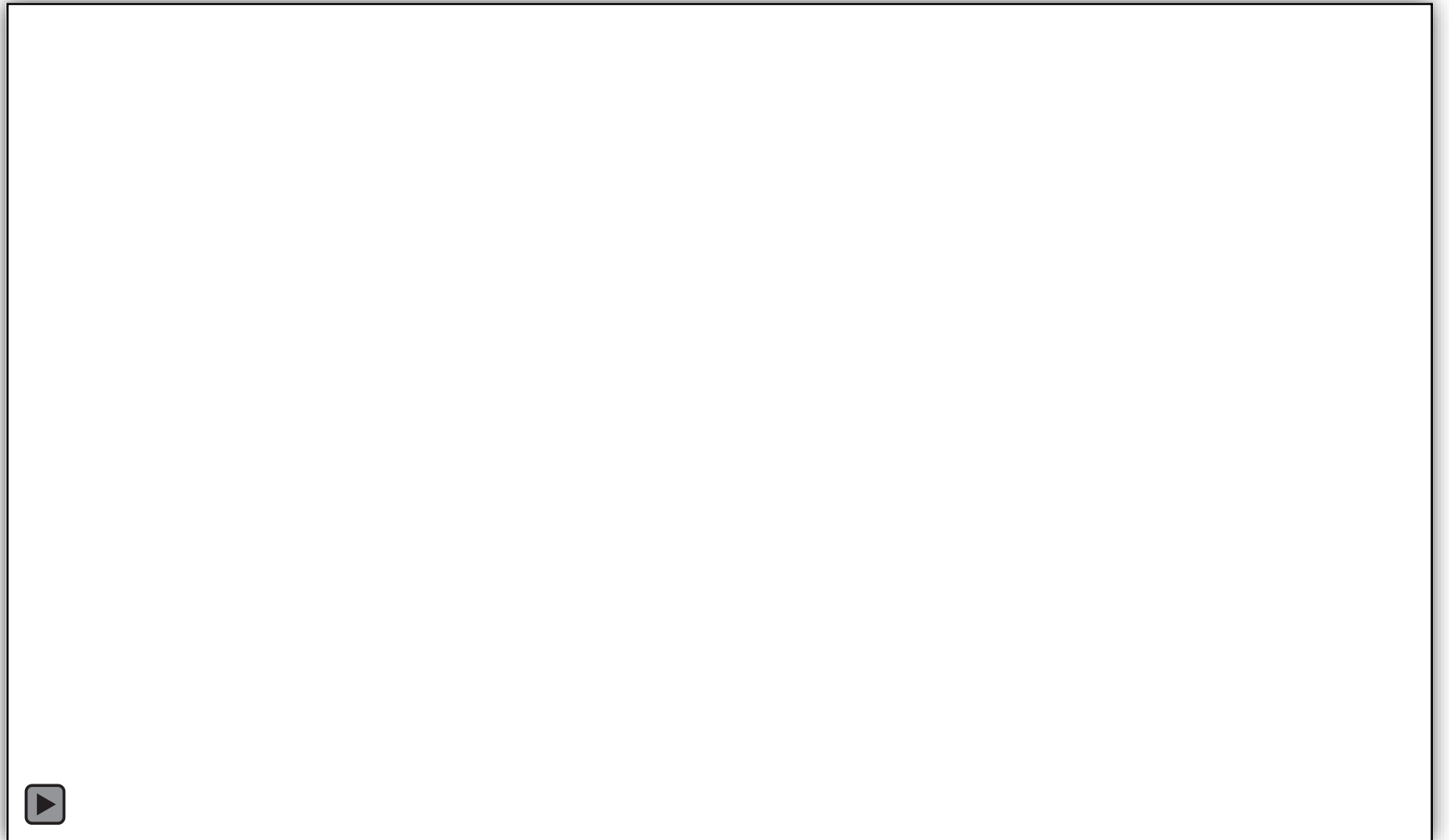
Criteria	Actual
Total Hours (To Date)	3,723,621
TRIR	0.37

- Offsite Fabrication & Design Assist
  - Pipe Racks
  - Process Super Skids
  - Clean Room Systems
  - Mechanical Skids & Stations



# Successes

- Weekly Meeting Cadence
- P6 Backbone Logic
- More consistent workforce
- Used Last Planner® in design
- Tracked PPC & Earned Value
- Production Strategy drove:
  - Visibility
  - Sequencing
  - Constraint Resolution
  - FLOW!





# How can you apply this tomorrow?

- *Owner & EPCM collaborate early on the strategy*
- *Inform, prepare and engage your partners early*
- *Prepare all teams to WORK TOGETHER*
- *Developing a production strategy takes time*
- *Release work when the production strategy is ready*



# Questions?







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**OCTOBER 19-22**



**In the spirit of continuous improvement, we would like to remind you to complete this session's survey! We look forward to receiving your feedback.**

# Contact Us

**Michael Cloud**

Jacobs

Michael.Cloud@jacobs.com

**Scott Donnelly**

Merck

Scott\_Donnelly@merck.com

**Jeff Beck**

Jacobs

Jeffrey.Beck@jacobs.com

**Mike D'Avanzo**

Total Facility Solutions

Mike.DAvanzo@tfs-us.com





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**Thank you for attending this presentation. Enjoy the rest of the 23<sup>rd</sup> Annual LCI Congress!**