Project X Mid-Atlantic Region, USA

Technical Report 2

Taylor M. Sweeney 16 October 2015

Construction Management | Dr. John Messner

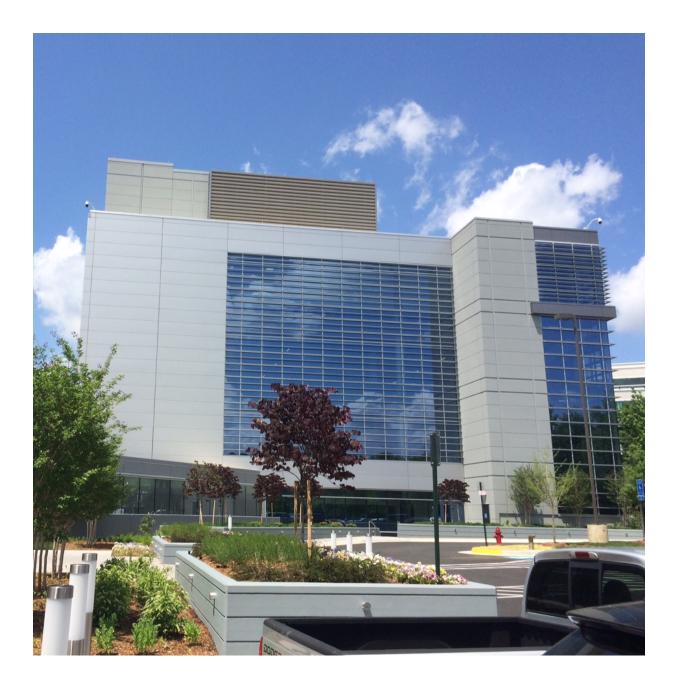


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Executive Summary

The system that Project X utilized for their mechanical system was a refrigerant system that encompasses the use of cooling towers and chillers. The mechanical system was designed to carry the load of the building with all four floor fit out. The contact for this particular phase only includes the construction of the base building and the fit out of the cellar, first floor, and second floor. The mechanical contract for this phase includes the preparation of each floor of the building as well as the installation of the equipment required for the base building and first and second floors.

The mechanical system installation took approximately 20 weeks. To complete this part of the project in the allotted time JCM utilized a crew of 12 men. The crew included one foreman, 2 welders, and 9 steamfitters. JCM also had three subcontractors working underneath them: a sheet metal contractor, an insulation subcontractor, and a rigging subcontractor. With these subcontractors and their own crew the mechanical system was smoothly installed, with only one hiccup when it came to the evacuation of the refrigerant system. The entire project schedule was set up as an accelerated schedule to ensure that the owner could move into the building as quickly as possible. With that being said the schedule for the mechanical system was accelerated so it was completed as quickly as possible.

The cost of the mechanical system was just over \$7 million, and according to my square foot estimate the mechanical system was supposed to be closer to \$8 million. These values are relatively close in nature. The difference can mostly be associated with the size of the contract.

When installing the mechanical system JCM just a few challenges. Even the size of the equipment didn't slow JCM down. One challenge that the crew faced was the fact that they have never implemented this type of system before, so to overcome this challenge they traveled to another project done by the owner that had the same system implemented. Other than that JCM battled the weather to ensure that their portion of the project was completed on time. Logistically JCM had no difficulties, the location of the cranes were perfect for them to be able to lift the cooling towers onto the roof.

Speaking with Steve Kozura from JCM Associates, I gained a better understanding of the mechanical system that was implemented and the challenges that the crew faced during the process.

Production Plan

System Construction Means and Methods

The system that was put into place was a refrigerant system. The system spans the entire building with the chillers located in the cellar and the cooling towers located on the roof. Refrigerant pipes are run from the cellar to the roof to transport the refrigerant back and forth. Water is cycled over the refrigerant and sent to the chiller where the chilled air expands into liquid form and cools, this in turn cools the building. The system was designed by Smardt Chiller Group and assembled in Canada and then shipped to the project location. This system is top of the line in terms of efficiency. The system while expensive up front but the energy efficiency in the long run results in a great money savings.

During the installation of this system, the quality and care of installation was of the utmost importance. For the system to operate at the highest quality output the evacuation of the refrigerant system. The evacuation of the system during the installation was one that was a difficult process but it had to be completed to the highest quality. The installation of the piping and ductwork also needed to be completed at the highest quality to ensure that they lined up perfectly. If the piping or ductwork were even a millimeter off from their intended location the system would not work as efficiently as planned or cause issues with coordination between other trades.

With the size of the equipment special means and methods were required to install. The install the cooling towers located on the roof cranes were needed to set them in place. JCM subcontracted the rigging out to move the cooling towers into place, as well as the chillers. With the chillers located in the cellar of the building, and the large size of the chillers it was easier to install in pieces instead of one large piece of equipment. The chillers came in smaller pieces and the crews then assembled the pieces in place. Also the CRAH units are large in size requiring a crane for movement into place. The rough in and installation of ductwork and piping a scissor lift was required because of the heights at which the piping and ductwork was installed.

Production Schedule

The crew size for this accelerated schedule was made up of 12 people. The typical crew consisted of 1 foreman, 2 welders, and 9 steamfitters. The foreman over saw the completion of the project, the welders welded the pipes together, and the steamfitters are pipe fitters for pipes that work with pipes that are under high pressure. JCM also had 3 subcontractors, one for ductwork, one for insulation of piping, and one for rigging the equipment into place.

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The mechanical system was installed from bottom up. Starting in the cellar JCM worked their way to the fourth floor, floor by floor, installing equipment and the roughing in the pipes and ductwork. The final part of each installation was the connection of the piping and ductwork. The very last step of the process was the testing and start-up of the system.

See Appendix A for the production schedule. The appendix includes the detailed schedule for just the mechanical system implementation as well as the overall schedule of the project with the full mechanical schedule implemented.

Detailed Costs

See Appendix B for the detailed cost estimate.

Site Plans and Logistics

See Appendix C for the updated site plan for this phase of the project.

Production Analysis

Production

As stated earlier the schedule was an accelerated schedule implemented to get the job completed in 20 weeks. The crew of 12 workers worked efficiently to implement the mechanical system in the set period of time. The usage of cranes and scissor lifts allowed the crews to keep to the schedule of 20 weeks with only one hiccup. The only hiccup that JCM faced was when it came to the evacuation of the refrigerant system. This accelerated schedule allowed for the other disciplines to move into the sections of the building on time to keep on schedule. This can be seen in the interview conducted with Steve Kozura from JCM who verified that the schedule was kept except for the evacuation of the refrigerant system. Kozura also confirmed that the site layout did not interfere with their production. JCM was able to see the site before and plan out their schedule accordingly.

Cost Analysis

The cost of the mechanical system was approximately \$5.5 million, according to my square foot estimate the mechanical system should have cost approximately \$8 million. This difference can be accounted for because of multiple reasons. The \$5.5 million corresponds to the installation of the mechanical equipment and its supporting system. The contract for JCM for VA2 only included the installation of 3 chillers and 3 cooling units along with the CRAH units, the square foot estimate included costs of installation for all the equipment required for the building not

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just a portion of the building. Also in this contract the owner provided the mechanical contractor with the machinery of system (i.e. the cost estimate does not include the cost of the chillers and cooling towers), which also accounts for the lower cost. With all of that given, the estimates line up with each other closely.

Logistical Analysis

The site of Project X was constrained due to the size and the existing conditions already on site. With not much room on the given site, the JCM trailers were located outside of the designated project boundaries. The project fence laid right off the building in most locations making the flow of work that much more difficult. Another added challenge was the number of cranes on site. The site during the mechanical system installation had 3 large cranes that each had a radius of 150'. With the space provided JCM worked as efficiently as they could with their crew of 12 workers. The size of equipment installed kept the only option of moving the chillers and cooling towers into place at cranes. The cranes were required to lift and move the equipment into place. The chiller was the root of a few challenges. With the chillers located in the basement it was difficult to install. With this in mind the chillers were shipped in pieces to be assembled in place. This made the installation very easy; the pieces were moved into the cellar and the assembled in their location. The ceiling of height throughout the building was over 15 feet for each floor, the use of scissor lifts made the installation of pipe and ductwork easy and efficient.

Logistically the two issues that JCM faced were egress and security. With limited access to the site comes with limited egress to the site. With any issue on site

Field Interview

The field interview was conducted with Steve Kozura with JCM Associates. JCM was tasked with the installation of the mechanical system for Project X. The owner of the product supplied JCM with all the equipment (chillers, cooling towers, pumps, and CRAH units etc.).

Schedule Acceleration Scenarios

This mechanical system does play a part in the project's critical path, but not a huge role. The rough in on each floor are the tasks that lie on the critical path. The biggest risks to the completion date for mechanical system include weather as well the coordination with other subcontractors. But the installation of the mechanical system was already on an accelerated schedule, so there were no ways to accelerate the schedule even more.

Constructability and Logistical Challenges

The two biggest challenges of the installation of the mechanical system were the weather and the shear size of the system elements. This mechanical system is a refrigerant-based system, meaning instead of utilizing water the chill the building the system. Before the system is put into use it must be evacuated of all moisture. The evacuation process removes noncondensables and dehydrates the system. If noncondensables are not removed the system will not run at its full capacity, as well as water vapor freezing up or acids mixing oil and metal to great a sludge. With wet weather conditions it moisture can build up in the system making it more difficult to evacuate the system before it is completely sealed. This process was originally schedule to take 1 week but because of the weather it took almost 2 full weeks.

The other challenge that JCM faced was the size of the equipment that they installed. The owner required a particular system be put in place and knowing this the architect designed the building so that the equipment could easily be installed. The cooling towers are located on the roof while the chillers are located in the cellar of the building. To install the cooling towers the crane had to be used to lift them onto the roof, and the chillers themselves actually came in parts to be assembled in the chiller room.

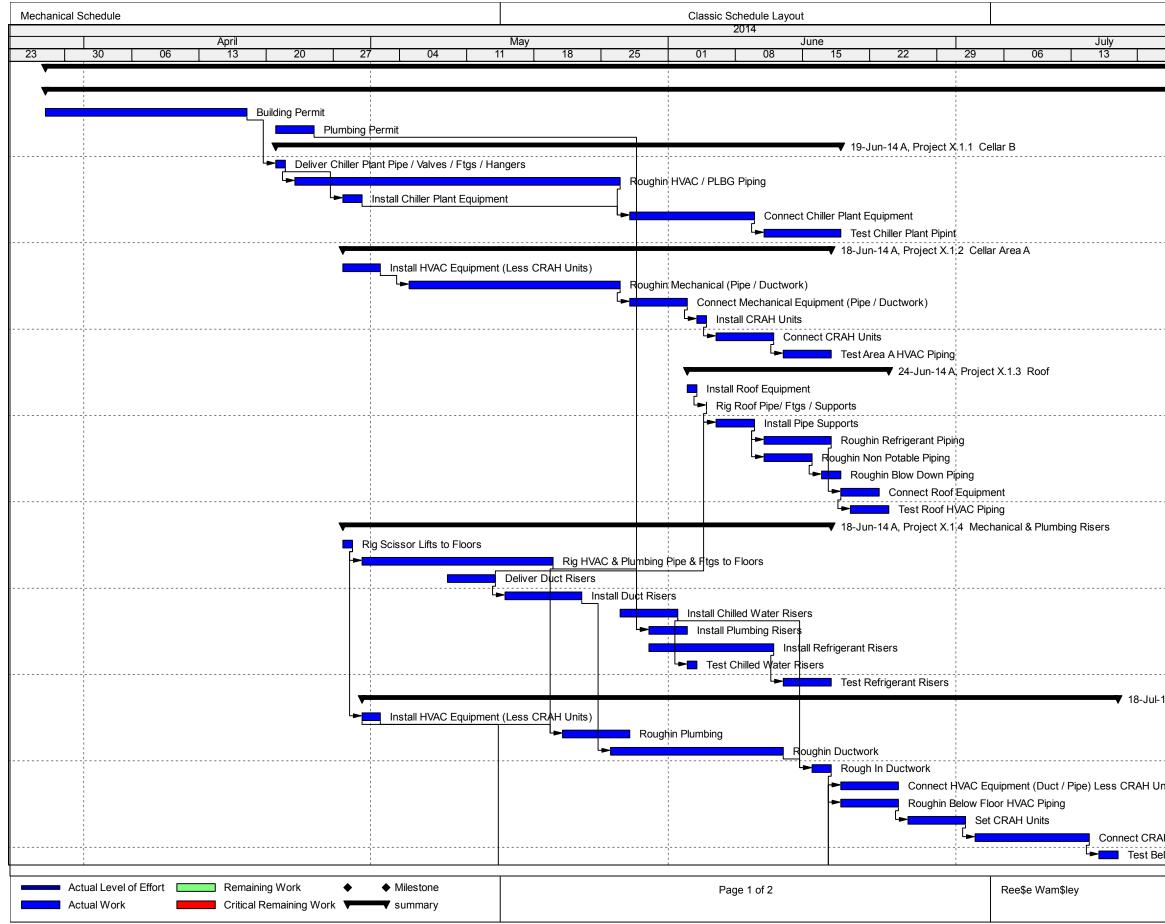
Appendix A

Production Schedule

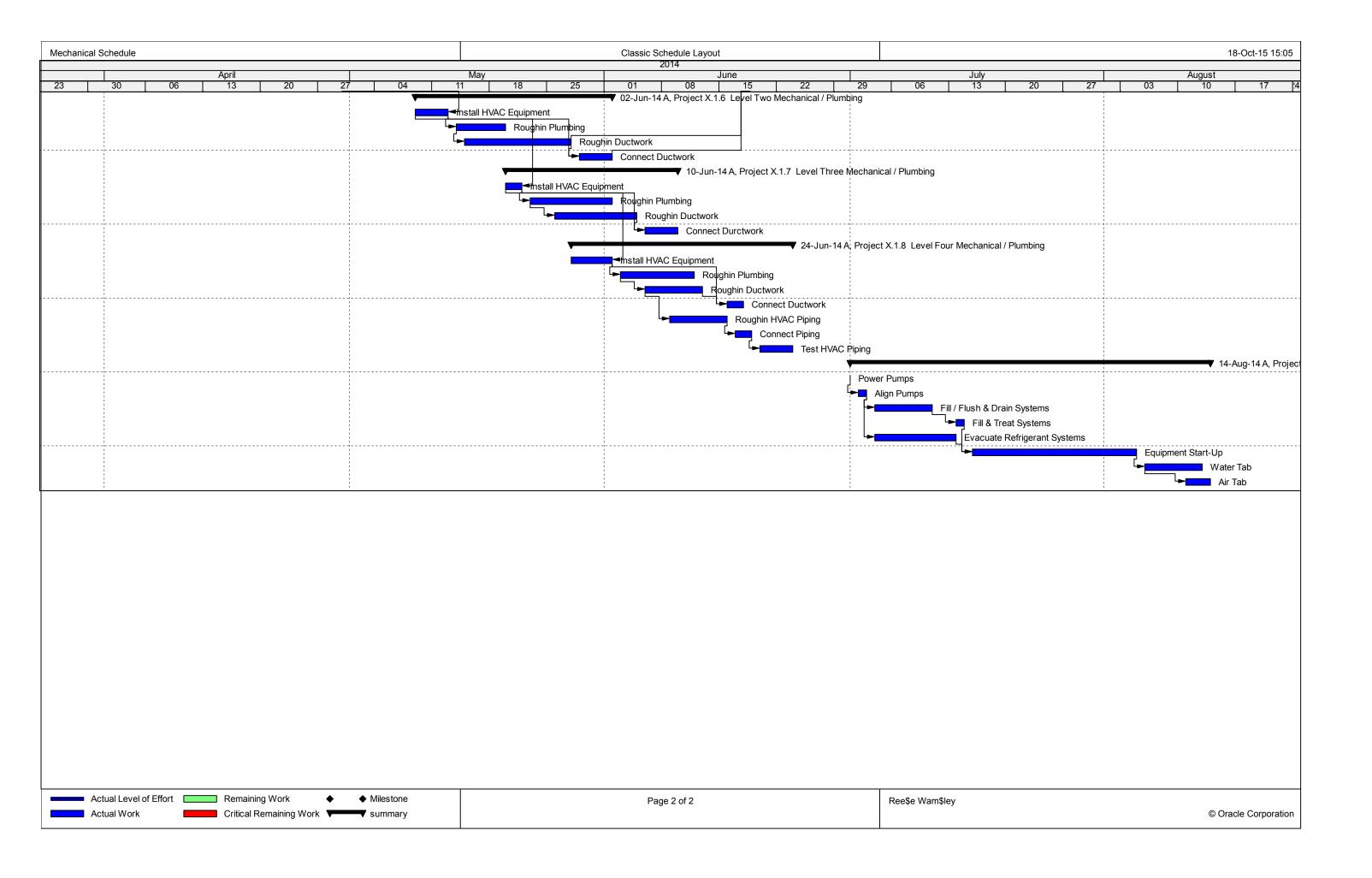
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# A	ctivity ID	Activity Name		Actual Duration	Start	Finish				
1	an Due		2 ale aduda		28-Mar-14 A	14-Aug-14 A				
		ject X Mechanical								
2	📑 P	roject X.1 Mechanica	I Installation Sc	99	28-Mar-14 A	14-Aug-14 A				
3		Building Permit		15	28-Mar-14 A	18-Apr-14 A				
1		Plumbing Permit		4	21-Apr-14 A	25-Apr-14 A				
5		Project X.1.1 Cellar B		43	21-Apr-14 A	19-Jun-14 A				
3		Deliver Chiller Plant Pipe / Va	ves / Ftgs / Hangers	1	21-Apr-14 A	22-Apr-14 A				
7		Roughin HVAC / PLBG Piping	ļ	24	23-Apr-14 A	27-May-14 A				
3		Install Chiller Plant Equipmen	t	2	28-Apr-14 A	30-Apr-14 A				
ə		Connect Chiller Plant Equipm	ent	9	28-May-14 A	10-Jun-14 A				
0		Test Chiller Plant Pipint		6	11-Jun-14 A	19-Jun-14 A				
1		Project X.1.2 Cellar Area	Α	37	28-Apr-14 A	18-Jun-14 A				
2		Install HVAC Equipment (Les	s CRAH Units)	4	28-Apr-14 A	02-May-14 A				
3		Roughin Mechanical (Pipe / D	Juctwork)	16	05-May-14 A	27-May-14 A				
4		Connect Mechanical Equipme	ent (Pipe / Ductwork)		28-May-14 A					
5		Install CRAH Units			04-Jun-14 A					
6		Connect CRAH Units		4	06-Jun-14 A	12-Jun-14 A				
7		Test Area A HVAC Piping		3	13-Jun-14 A	18-Jun-14 A				
8		Project X.1.3 Roof			03-Jun-14 A					
9		Install Roof Equipment		1	03-Jun-14 A	04-Jun-14 A				
0		Rig Roof Pipe/ Ftgs / Support	S		05-Jun-14 A					
1		Install Pipe Supports			06-Jun-14 A					
2		Roughin Refrigerant Piping			11-Jun-14 A					
3		Roughin Non Potable Piping			11-Jun-14 A					
4		Roughin Blow Down Piping			17-Jun-14 A					
5		Connect Roof Equipment			19-Jun-14 A					
6		Test Roof HVAC Piping			20-Jun-14 A					
7			9 Diumbing Diseas		28-Apr-14 A					
		Project X.1.4 Mechanical Rig Scissor Lifts to Floors	& Plumbing Risers							
8 9			Etao to Elooro		28-Apr-14 A 30-Apr-14 A	·				
		Rig HVAC & Plumbing Pipe &	FIGS TO FIDOIS		· ·					
0		Deliver Duct Risers			09-May-14 A	-				
1		Install Duct Risers			15-May-14 A					
2		Install Chilled Water Risers			27-May-14 A					
3		Install Plumbing Risers			30-May-14 A					
4		Install Refrigerant Risers			30-May-14 A					
5		Test Chilled Water Risers			03-Jun-14 A					
6		Test Refrigerant Risers			13-Jun-14 A					
7		Project X.1.5 Level One M			30-Apr-14 A					
8		Install HVAC Equipment (Les	s CRAH Units)		30-Apr-14 A	-				
9		Roughin Plumbing			21-May-14 A					
0		Roughin Ductwork			26-May-14 A					
1		Rough In Ductwork			16-Jun-14 A					
2		Connect HVAC Equipment (D			19-Jun-14 A					
3		Roughin Below Floor HVAC F	Piping		19-Jun-14 A					
4		Set CRAH Units			26-Jun-14 A					
5		Connect CRAH Units			03-Jul-14 A	15-Jul-14 A				
6		Test Below Floor HVAC Pipin	g	2	16-Jul-14 A	18-Jul-14 A				
			Page	1 of 2		TASK filter: All Activitio	es			

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#	Activity	tivity ID Activity Name			Actual Duration	Start	Finish	
47		P.	Project X.1.6 Level Two M	echanical / Plumbi	16	09-May-147	A 02-Jun-14 A	
18			Install HVAC Equipment		2	09-May-14	A 13-May-14 A	
49			Roughin Plumbing		4	14-May-14	A 20-May-14 A	
0			Roughin Ductwork		9	15-May-14	A 28-May-14 A	
1			Connect Ductwork		2	29-May-14	A 02-Jun-14 A	
2		-	Project X.1.7 Level Three	Mechanical / Plum	15	20-May-14	4 10-Jun-14 A	
3			Install HVAC Equipment		2	20-May-14	A 22-May-14 A	
ŀ			Roughin Plumbing		6	23-May-14	A 02-Jun-14 A	
5			Roughin Ductwork		8	26-May-14	A 05-Jun-14 A	
6			Connect Durctwork		2	06-Jun-14 A	A 10-Jun-14 A	
7		-	Project X.1.8 Level Four M	lechanical / Plumb	19	28-May-14	A 24-Jun-14 A	
3		_	Install HVAC Equipment		3	28-May-14	A 02-Jun-14 A	
)			Roughin Plumbing		7	03-Jun-14 A	A 12-Jun-14 A	
)			Roughin Ductwork		5	06-Jun-14 A	A 13-Jun-14 A	
1			Connect Ductwork		2	16-Jun-14 A	A 18-Jun-14 A	
2			Roughin HVAC Piping		5	09-Jun-14 A	A 16-Jun-14 A	
3			Connect Piping		2	17-Jun-14 A	A 19-Jun-14 A	
4			Test HVAC Piping		2	20-Jun-14 A	A 24-Jun-14 A	
5		-	Project X.1.9 Testing / Sta	rt-up / Pre-Comiss	32	01-Jul-14 A	14-Aug-14 A	
6			Power Pumps		0	01-Jul-14 A	01-Jul-14 A	
7			Align Pumps		1	02-Jul-14 A	03-Jul-14 A	
8			Fill / Flush & Drain Systems		5	04-Jul-14 A	11-Jul-14 A	
9			Fill & Treat Systems		1	14-Jul-14 A	15-Jul-14 A	
0			Evacuate Refrigerant System	6	6	04-Jul-14 A	14-Jul-14 A	
			Equipment Start-Up		14	16-Jul-14 A	05-Aug-14 A	
2			Water Tab			06-Aug-14 A	A 13-Aug-14 A	
3			Air Tab		3	11-Aug-14 A	A 14-Aug-14 A	

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20	27			03		Auę	gust 10		17		24
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Activi	ty ID Activity Name		Actual Duration	Start	Finish	
1	Project X Mechanica	al Schedule	99	11-Feb-13	B A 05-Dec-14	
	Project X.2 Overall	Schedule	0	11-Feb-13	3 11-Nov-14	
	Recieve Design Drawing		0	11-Feb-13	3 14-Feb-13	
	Complete Contact		0	14-Feb-13	3 28-May-13	
	Award Contract		0	12-Apr-13		
	Issue NTP to Early Conta	ictors		28-May-1	· ·	
	Perform Preconstruction			12-Jun-13	-	
	Install Temporary Fencing	•	0	12-Jun-13	3 23-Jul-13	
	Excavation		0	05-Jul-13	12-Nov-13	
	Caissons		0	25-Jul-13	23-Aug-13	
	Site Utilities		0	31-Jul-13	25-Apr-14	
	Concrete Foundations		0	23-Oct-13	3 28-Apr-14	
	Mechanical & Plumbing		0	26-Dec-1	3 11-Nov-14	
	Project X.1 Mechan	ical Installation Sc		28-Mar-14		
	Building Permit		15	28-Mar-14	4 A 18-Apr-14 A	
	Plumbing Permit			21-Apr-14	•	
	Project X.1.1 Cellar B			21-Apr-14	•	
	Deliver Chiller Plant Pipe	/ Valves / Ftgs / Hangers	1	21-Apr-14	A 22-Apr-14 A	
	Roughin HVAC / PLBG P		24	23-Apr-14	A 27-May-14 A	
	Install Chiller Plant Equipr			28-Apr-14		
	Connect Chiller Plant Equ			28-May-14	·	
	Test Chiller Plant Pipint	•				
	Project X.1.2 Cellar A	rea A	37	28-Apr-14	A 18-Jun-14A	
	Install HVAC Equipment (4	28-Apr-14	A 02-May-14 A	
	Roughin Mechanical (Pip		16	05-May-14	4 A 27-May-14 A	
	Connect Mechanical Equ		4	28-May-14		
	Install CRAH Units			04-Jun-14		
	Connect CRAH Units		4	06-Jun-14	A 12-Jun-14 A	
	Test Area A HVAC Piping		3	13-Jun-14	1A 18-Jun-14A	
	Project X.1.3 Roof		15	03-Jun-14	A 24-Jun-14 A	
	🗧 Install Roof Equipment		1	03-Jun-14	A 04-Jun-14 A	
	🗧 Rig Roof Pipe/ Ftgs / Sup	ports	0	05-Jun-14	1A 05-Jun-14A	
	Install Pipe Supports		2	06-Jun-14	A 10-Jun-14 A	
	a Roughin Refrigerant Pipir	ıg	5	11-Jun-14	A 18-Jun-14 A	
	Carl Roughin Non Potable Pip	ing	3	11-Jun-14	A 16-Jun-14A	
	🗧 Roughin Blow Down Pipir	g	2	17-Jun-14	4A 19-Jun-14A	
	Connect Roof Equipment		2	19-Jun-14	1A 23-Jun-14A	
	Test Roof HVAC Piping		2	20-Jun-14	1A 24-Jun-14A	
	Project X.1.4 Mechan	ical & Plumbing Risers	37	28-Apr-14	A 18-Jun-14 A	
	Rig Scissor Lifts to Floors	3	1	28-Apr-14	·	
	🗧 Rig HVAC & Plumbing Pip	e & Ftgs to Floors	14	30-Apr-14	A 20-May-14 A	
	E Deliver Duct Risers		3	09-May-14	4 A 14-May-14 A	
	Install Duct Risers		6	15-May-14	4 A 23-May-14 A	
	Install Chilled Water Rise	rs	4	27-May-14	4 A 02-Jun-14 A	
	Install Plumbing Risers		2	30-May-14	4 A 03-Jun-14 A	
	Install Refrigerant Risers		9	30-May-14	4 A 12-Jun-14 A	
		Page 1	of 2		TASK filter: All Activities	

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Ac	tivity ID	Activity Name		Actual Duration	Start		=inish	
_					00 1			1
		Test Chilled Water Risers			03-Jun-14		04-Jun-14 A	_
		Test Refrigerant Risers			13-Jun-14		18-Jun-14 A	
		Project X.1.5 Level One			30-Apr-14		18-Jul-14 A	
		Install HVAC Equipment (Le	ess CRAH Units)		30-Apr-14		02-May-14 A	_
		Roughin Plumbing			21-May-14		28-May-14 A	_
		Roughin Ductwork			26-May-14		13-Jun-14 A	_
		Rough In Ductwork			16-Jun-14		18-Jun-14 A	_
		Connect HVAC Equipment	,		19-Jun-14		25-Jun-14 A	_
		Roughin Below Floor HVAC	Piping		19-Jun-14		25-Jun-14 A	_
		Set CRAH Units			26-Jun-14		02-Jul-14 A	
		Connect CRAH Units			03-Jul-14		15-Jul-14 A	_
		Test Below Floor HVAC Pip	5		16-Jul-14		18-Jul-14 A	
		Project X.1.6 Level Two	Mechanical / Plumbi		09-May-14		02-Jun-14 A	
		Install HVAC Equipment			09-May-14		13-May-14 A	_
		Roughin Plumbing			14-May-14		20-May-14 A	_
	_	Roughin Ductwork		9	15-May-14	4A 2	28-May-14 A	_
		Connect Ductwork		2	29-May-14)2-Jun-14 A	
		Project X.1.7 Level Thre	ee Mechanical / Plum	15	20-May-14	4 A	10-Jun-14 A	
		Install HVAC Equipment		2	20-May-14	4A 2	22-May-14 A	
		Roughin Plumbing		6	23-May-14	4A (02-Jun-14 A	
		Roughin Ductwork		8	26-May-14	4 A (05-Jun-14 A	
		Connect Durctwork		2	06-Jun-14	4 A 🥂	10-Jun-14 A	
		Project X.1.8 Level Fou	r Mechanical / Plumbi	19	28-May-14	4A 2	24-Jun-14 A	
		Install HVAC Equipment		3	28-May-14	4A ()2-Jun-14 A	1
		Roughin Plumbing		7	03-Jun-14	4 A 🤺	12-Jun-14 A	
		Roughin Ductwork		5	06-Jun-14	4 A 🤺	13-Jun-14 A	
		Roughin HVAC Piping		5	09-Jun-14	4 A 🤺	16-Jun-14 A	
		Connect Ductwork		2	16-Jun-14	4 A 🤺	18-Jun-14 A	-
		Connect Piping		2	17-Jun-14	4 A 🥂	19-Jun-14 A	-
		Test HVAC Piping		2	20-Jun-14	4 A 🛛 🕹	24-Jun-14 A	-
		Project X.1.9 Testing / S	itart-up / Pre-Comissi	32	01-Jul-14	A '	14-Aug-14 A	
		Power Pumps		0	01-Jul-14	A (01-Jul-14 A	-
		Align Pumps		1	02-Jul-14	A (03-Jul-14 A	-
		Fill / Flush & Drain Systems	;	5	04-Jul-14	A '	11-Jul-14 A	-
		Evacuate Refrigerant Syste		6	04-Jul-14	A '	14-Jul-14 A	-
		Fill & Treat Systems		1	14-Jul-14	A '	15-Jul-14 A	1
		Equipment Start-Up		14	16-Jul-14	A ()5-Aug-14 A	1
		Water Tab			06-Aug-14		13-Aug-14 A	-
		Air Tab		3	11-Aug-14		14-Aug-14 A	-
		roject X.0 Overall P	roiect 1	0	30-Jan-14)5-Dec-14	
		Steel Structure			30-Jan-14)4-Apr-14	1
		Generators			07-Apr-14		14-Jul-14	-
		Building Skin			01-May-14		18-Aug-14	-
		Cellar Buildout			15-May-14		03-Sep-14	-
		Roofing			23-May-14		03-3ep-14 04-Aug-14	-
		Electrical			02-Jun-14		11-Nov-14	_
		Connector Bridges			02-Jul-14		05-Aug-14	_
			1	0	02-Jul-14		55-Aug-14	

Mechanical Sched		Classic Sched				18-Oct-15 15:37
# Activity ID	Activity Name		Actual Duration	Start	Finish	
94	1st Floor Buildout		0	02-Jul-14	25-Sep-14	
95	Final Sitework			02-Jul-14		
96	4th Floor Buildout			16-Sep-14		
97	3rd Floor Buildout			23-Sep-14		
98	2nd Floor Buildout			30-Sep-14		
99	Issue Temporary Certicate	of Occupancy		12-Nov-14		
100	Final Punchlist			13-Nov-14		
		Page 3	of 3		TASK filter: All Activi	ties © Oracle Corporation

lechanical Schedule				013			Classic Schedule Layout								2014		
ary March 7 24 03 10 17 24 31	April 1 07 14 21 28	May 3 05 12 19 26	June	013 July 30 07 14 21 2	August 28 04 11 18 25	September 01 08 15 22	October Nov 29[06]13[20]27[03]1	vember 10 17 24 0	December 01 08 15 22 2	January 9[05]12[19]26	February	March 02 09 16 23	April 30 06 13 20 2	May June [27]04[11]18[25]01[08]15[22]			
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Appendix B

Detailed Cost

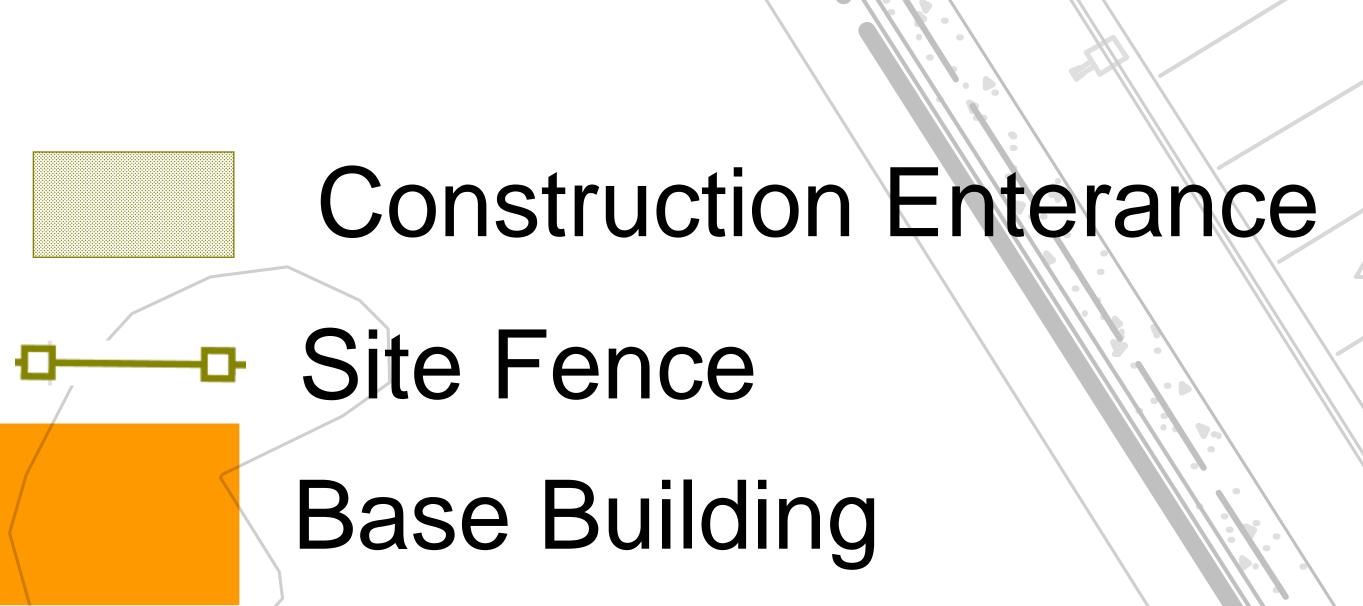
Group	Phase	Description	Labor Amount	Material Amount	Other Amount	Total Cost/Unit	Total Amount
1000.000		GENERAL CONDITIONS					
	1050.100	Permits					
		Plumbing Permits	-	150,000	-	150,000.00 /ls	150,000
	1055.100	Insurance		,			
		Bonds	-	55,000	-	55,000.00 /ls	55,000
	1100.100	Project Management					
		Project Manager	55,000	-	-	2,850.00 /wk	57,000
		Assit. Project Manager	25,000	-	-	1,325.00 /wk	26,500
	1104.100	Field Foreman					
		Mechanical Foreman	45,000	-	-	2,250.00 /wk	45,000
		Mechanical Foreman	45,000	-	-	2,250.00 /wk	45,000
	1250.100	Offices					
		Office Trailer	-	-	20,000	/mo	20,000
		Office Trailer	_	-		/mo	
	1255.100	Documentation				////0	
	1233.100	Coordination of drawings			60,000	/mo	60,000
		Submittals			45,000	/mo	45,000
	1260.100	Utilities			10,000	////0	40,000
	1200.100	Temporary Toilets			37,000	/mo	37,000
	1070 100				07,000	////0	57,000
	1270.100	OSHA & Safety			20,000	//o	20.000
	4070.400	Miscellaneous Safety			20,000	/ls	20,000
	1370.100	Scheduling		60.000			
		Scheduling Conceptual- Coordination	0	60,000	-	/ls	60,000
		Ductwork					
		Scheduling Conceptual- Coordination	0	90,000	-	/ls	90,000
		Plumbing					
	1380.100	Punch List					
		Punch List by LS			90,000	/ls	90,000
	1400.100	Mobilization					
		Mobilization		-	200,000	/wk	200,000
15080.00 0	15080.305	MECHANICAL INSULATION					
		Duct Exterior insulation 2"	50,000	22,000	-	/sf	72,000
		Ductwork	290,000	205,000	-	/sf	495,000
15130.00 0		PUMPS					
	15130.022	Pumps Chill Water					
		Chill Pumps 50 hp -1200 gpm	152,000	0	-	/ea	152,000
	15130.026	Plumbing Pumps					
	10100.020	Cent Pumps Plumbing	58,000	55,000	-	/ea	113,000
15400.00 0		PLUMBING					,
	15410.004	Plumbing per Fixture					
		Plumbing Fixtures	12,000	35,000	-	/ea	47,000
		Plumbing Piping	447,000	-	-	/ea	447,000
15500.00		HEAT GENERATION					
0							
	15510.009	Oil Equipment					

Group	Phase	Description	Labor Amount	Material Amount	Other Amount	Total Cost/Unit	Total Amount
	15510.009	Oil Equipment					
		Piping (Allowance)		0	550,000	/ea	550,000
15600.00 0		REFRIGERATION					
	15620.004	Chillers Place					
		Set Chillers	240,000	-	55,000	/mh	295,000
		Refigerant Piping and Risers	525,000	-	-	/mh	525,000
	15620.006	Chilled Water					
		Chiller Risers and Piping	420,000	97,000	-	/ea	517,000
		Start Up Chillers	190,000		-	/ea	190,000
	15640.004	Cooling Towers					
		Set Cooling Towers	8,000	-	100,000	/mh	108,000
		Refrigerant Piping	50,000	-	-	/mh	50,000
15700.00 0		HVAC EQUIPMENT					
	15730.006	AHUs					
		AH Units		75,000	-	/ea	75,000
	15750.404	Humidifiers					
		Reverse Osmosis System	110,000		-	/ea	110,000
		Reverse Osmosis System	60,000	150,000	-	/ea	210,000
15800.00 0		AIR DISTRIBUTION					
	15820.004	Damper - Fire					
		Damper Fire 160~ Fuse 48 x 48	6,000		-	/ea	6,000
	15840.006	VAV					
		VAV Box # 1	276,000	40,000	-	/ea	316,000
	15850.022	Register/ Grilles/Diffusers					
		Register / Grilles/ Diffusers	23,000		-	/ea	23,000
15950.00 0		TEST-ADJUST-BALANCE					
	15950.102	Equipment Test/Balance					
		Equipment Test & Balance	-	77,000	-	/ls	77,000
	15950.112	Air Balancing					
		Fan Coil Units - Ceiling	17,000	60,000	-	/ea	77,000

Description	Amount	Totals	Hours	Rate	Cost Basis	Cost per Unit	Percent of Total
Labor	3,104,000		3,200.000 hrs				56.90%
Material	1,171,000						21.46%
Subcontract							
Equipment	3,500		1,600.000 hrs				0.06%
Other	1,177,000						21.57%
	5,455,500	5,455,500					100.00
Total					Т		
		5,455,500					
Total		5,455,500					

Appendix C

Site Logistics Plan



CONTRACTOR TO COORDINATE

FOOTING DEPTH AND STEP LOCATIONS WITH CIVIL GRADES. PROVIDE MIN. 2'-0" COVER TO TOP OI DOTING FROM LOW GRADE SIDE C

WALL. COORDINATE SUMP STEPS/LOCATIONS REQUIREMENTS WITH MEP DRAWINGS.

G1 S302 C12x20.7 STAIR STRINGER UP

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Temporary Stairs

Temporary Offices

Work Flow


Material Laydown

Temporary Facilities Existing Building

Dumpsters

Crane Path

Parking



Appendix D

Field Supervisor Interview