23 December 2020

to the Director General of the Clinical Trial Materials Facility
National Research Council Canada
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RE: CTMF Feasibility Report Review and CTMF Greenfield Cost Estimate

The consulting firm is pleased to submit our review of the CTMF Feasibility Report Issued by a previous consultant on November 27, 2020 to NRC. We have also included the cost estimate and schedule to design and build a similar facility on the same site at Royalmount. As a fully integrated design firm providing architecture, engineering, procurement, construction administration/ management, and commissioning and qualifications services, we have a thorough understanding of the requirements for this project.

EXECUTIVE SUMMARY

The consulting firm has reviewed the CTMF Feasibility Report issued by the previous consultant on November 27th, 2020. The consulting firm response is summarized in the following sections:

1. Review of the Feasibility Report Issued by the previous consultant
2. Cost and schedule for the greenfield CTMF
3. Risks and Opportunities.

1. REVIEW OF THE FEASIBILITY REPORT ISSUED BY THE PREVIOUS CONSULTANT

In summary, The consulting firm recommends that building a greenfield CTMF facility is the most cost effective and expeditious solution for NRC. Some of the highlights for your consideration are as follows:

1. Facility Design	a. Facility design could be optimized to support CL2 requirements and floor to ceiling heights to allow maintenance accessibility.
2. Schedule	b. The need to relocate the L4 occupants is removed from the schedule, providing greater schedule certainty.

	Building construction work can start much sooner. c. The unknowns of existing building mechanical plant capacity are removed. d. Any work associated with potential existing contamination are removed. e. A schedule completion date can be accurately established at the onset of the project.
3. Budget	a. The cost of a new facility can be fully established from the onset of the project and forecasted accurately. b. Relocation costs are avoided. c. There is a discrepancy of approximately $9 million CAD in the process equipment costs based on the fact that the previous consultant has assumed that NRC will be utilizing existing equipment vs. purchasing all new.
4. Project delivery system	a. It is much easier to proactively manage building a new facility in a fast-track project delivery system that has the design and construction proceeding simultaneously. b. Without the risk of unknowns of an existing facility, more accurate scopes of work can be established for the trade contractors thereby reducing the risk of extras. This is a big factor in cost certainty.

Details are highlighted in the sections of this report.

2. GREENFIELD COST ESTIMATE AND SCHEDULE

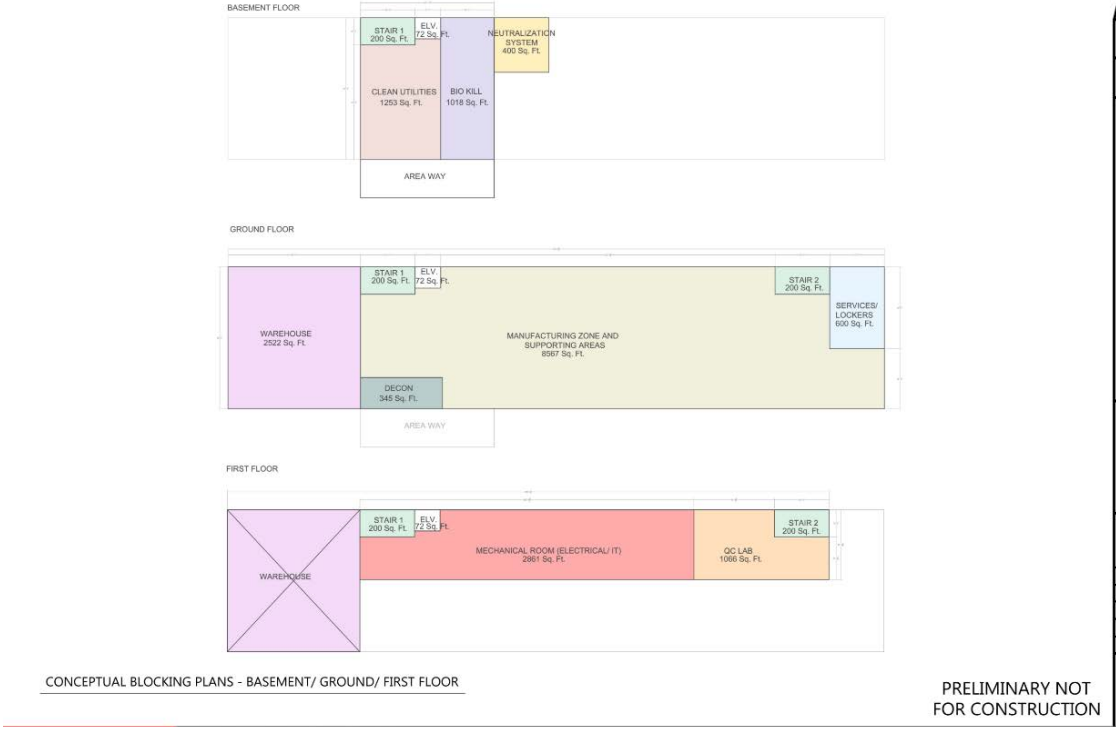
Design Assumptions

The estimate was based on a preliminary architectural Blocking and Stacking diagram. This diagram was intended to be the basis of a comparison for a greenfield option over a brownfield option shown in the previous feasibility study by the previous consultant dated 27 November 2020.

The Blocking and Stacking diagram is not a design. It simply arranges the spaces and attempts to stack those spaces in an efficient arrangement and provide a building area for the estimate.

The design assumes that we are connecting to the existing loading dock. There appears to be adequate area on the site to construct the addition as shown on the blocking plan. The warehouse is the connection point to the existing loading dock. At the other end of the new addition the employee entrance and locker rooms mean a separate entrance for staff. The Basement level allows for the bio-kill system, the clean utilities and the neutralization system. An external areaway allows access for tanks and large equipment through this hoist way down to overhead doors into the basement. The ground floor will provide a similar layout as the brownfield option but will establish uni-directional process flows.

The design layout does not address site design issues such as parking and walkways.



Cost Estimate

The consulting firm was asked to provide a cost estimate for the greenfield CTMF on the Royalmount site, and this is compared to the cost estimate for the brownfield project as shown in the table below:

L4 Renovation/Greenfield New Build Budget Comparison

Wednesday, December 23, 2020

Description	L4 Renovation Estimate)	Greenfield process EQ assumption)	Greenfield All New Process EQ	Comments
Mechanical				
Plumbing	$ 650,500.00	$ 850,000.00	$ 850,000.00	
HVAC	$2,715,000.00	$ 3,450,000.00	$ 3,450,000.00	
Fire Protection	$ 96,000.00	$ 85,000.00	$ 85,000.00	
Instrumentation & BMS	$ 584,500.00	$ 525,000.00	$ 525,000.00	
New City Sanitary Allowance	Use extg.	$ 50,000.00	$ 50,000.00	
New City Sewer Allowance	Use extg.	$ 50,000.00	$ 50,000.00	
New City Water Allowance	Use extg.	$ 75,000.00	$ 75,000.00	
Electrical	$ 804,769.00	$ 950,000.00	$ 950,000.00	
New Street Electrical Service Allow.	Use extg.	$ 150,000.00	$ 150,000.00	
Structure	$ 214,400.00	$ 1,202,500.00	$ 1,202,500.00	
Cladding	$ 72,000.00	$ 1,125,000.00	$ 1,125,000.00	
Finishes	$1,094,000.00	$ 1,170,000.00	$ 1,170,000.00	
Civil Work	$ 100,000.00	$ 775,000.00	$ 775,000.00	
Demolition	$1,462,000.00	$ 2,500.00	$ 2,500.00	
Elevators	$ 200,000.00	$ 200,000.00	$ 200,000.00	
Prefab. Clean Rooms	$3,171,000.00	$ 4,250,000.00	$ 4,250,000.00	
Subtotal Building	**$11,164,169.00**	**$ 14,910,000.00**	**$ 14,910,000.00**	
QC Lab Equipment	$ 1,099,000.00	$ 1,099,000.00	$ 1,099,000.00	
Process equipment NEW (reusing existing equipment)	$ 4,581,000.00	$ 4,581,000.00	$ -	
Process EQ New (All)			$ 12,823,532.85	
Automation	$ 1,445,000.00	$ 1,445,000.00	$ 1,945,000.00	
Clean Utilities	$ 1,993,135.00	$ 1,993,135.00	$ 3,190,285.00	
Subtotal Process	**$9,118,135.00**	**$9,118,135.00**	**$ 19,057,817.85**	
General Equip. & Furn.	$ 396,000.00	$ 396,000.00	$ 396,000.00	
Site General Conditions	$ 1,083,000.00	$ 1,471,800.00	$ 1,471,800.00	
CM Fee	$ 1,160,000.00	$ 1,312,381.22	$ 1,401,838.36	6% (Building, Site General conditions, General Eq & Furnishings, Desing Development and construction contingency
Design Development	$ 3,780,000.00	$ 3,604,220.25	$ 5,095,172.68	15% of building costs 15%Equipment
Construction Contingency	Included	$ 1,491,000.00	$ 1,491,000.00	10% of building costs
Design Fees * Site Support	$ 1,470,000.00	$ 2,883,376.20	$ 4,076,138.14	12% of TIC (Process and building)
Validation	$ 827,506.00	$ 679,556.75	$ 1,176,540.89	1.5% building & 5% Process
Subtotal Building/Fees	**$28,998,810.00**	**$35,866,469.42**	**$49,076,307.92**	
Relocate Existing L4 Occupants Fit out new space 15,740sf x $750/sf(labs assumed)	$11,805,000	Not required	Not required	Cost includes design, construction and move of extg. L4 occupants.
Total Project Cost	**$40,803,810.00**	**$ 35,866,469.42**	**$ 49,076,307.92**	
Final Schedule Completion	**December 2022**	**July 2022**	**July 2022**	L4 Reno original completion of Feb 2022 adjusted to include for award of Arch/Eng in January and 8 mths of design, construction, move of extg occupants to new space.

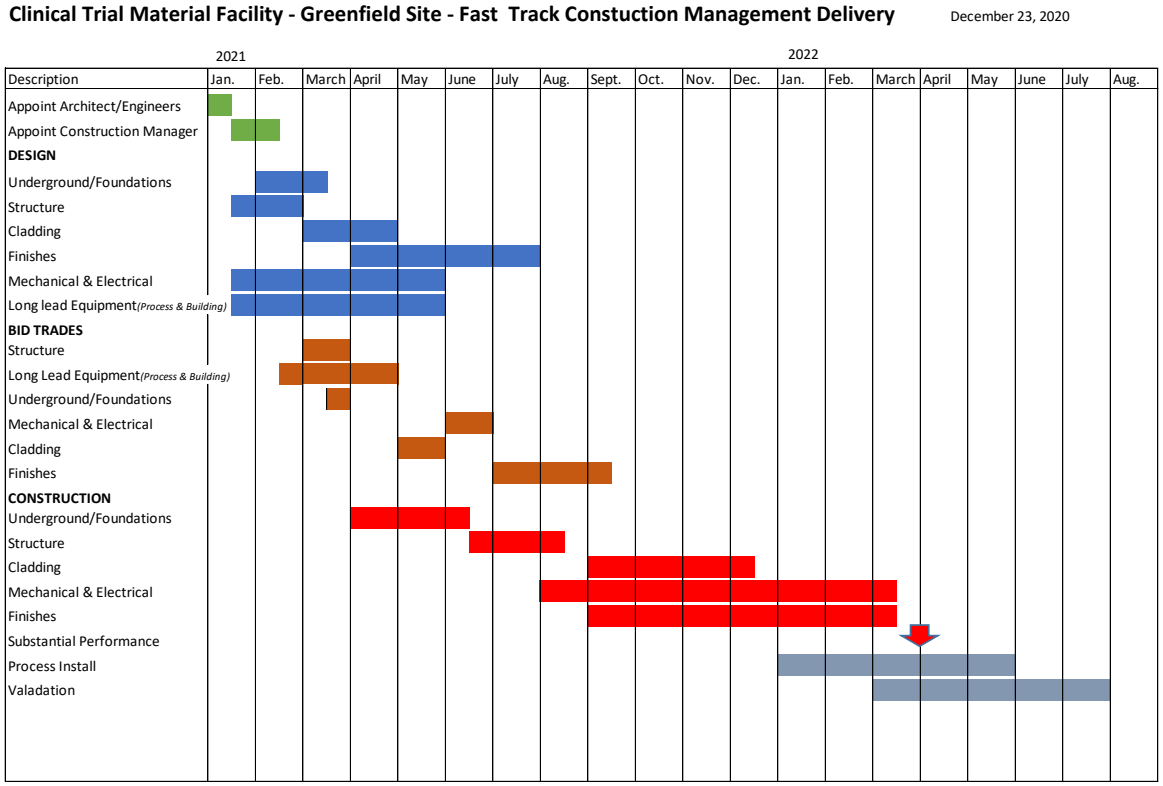
Assumptions:

- We have measured quantities where possible and applied typical unit rates. Where specific design information is not available, unit rates are based on historical cost data for this type of project in the Montreal vicinity. Where design information is limited we have made reasonable assumptions based on our experience with projects of a similar scope and complexity.
- Unit rates include labor and material, equipment and subcontractors OH&P.
- Estimate has been prepared on the assumption that the work will be performed within the timelines as shown on the attached schedule.
- Winter construction has been allowed for in the estimate.
- The fee element is meant to cover the General Contractor's fee to perform the work.
- Construction insurance costs are covered in the OH portion of the estimate.
- Soft costs have been excluded from the estimate (disbursements, independent inspection and testing, legal fees, permits and development charges, moving expenses, taxes).
- Contingencies for Design and Construction have been included in the estimate as a percentage of the hard construction costs. The percentages are appropriate for this stage of the project and the extent of the design information available. Escalation contingency is not included due to the fast-track nature of the project
- All process equipment will be new and not re-used from the existing facility. The list of equipment along with lead times can be found in Appendix 1.

Exclusions:

- Costs for site remediation
- Costs for special foundations

Schedule



3. RISKS AND OPPORTUNITIES

A number of risks and opportunities have been identified for consideration. The Risks and Opportunities are identified In Table 3 below:

Comment	Risk	Opportunity
Relocation of the existing L4 occupants	a. A new home for the existing occupants is not identified creating schedule uncertainty.	No interruption to existing business operation (except for coordinating shutdowns for tie-ins when appropriate)
	b. Significant work will be required at the location of the new home to accommodate these occupants. The time allowed in the current schedule appears optimistic.	
Unknown risks with moving CTMF into L4	a. Will the existing plumbing be reusable? Current budget and schedule assume it is.	Greenfield construction will require new piping in the new facility

Comment	Risk	Opportunity
	b. Existing mechanical plant for heating steam, chilled water, compressed air and sanitary assumed to have capacity for the CTMF.	
	c. The existing BAS is assumed to be up to date and has the capacity to accommodate the CTMF.	
	d. There is not enough generator capacity to support the CTMF and a new Genset is not included in the new budget.	
	e. Are the existing building footprint and floor-to-floor heights sufficient for the CTMF	Greenfield construction will allow for proper floor to floor heights, and proper GMP layouts to meet CL2 compliance.
	f. Unknown hazardous materials in the existing facility.	
Schedule risks	a. Relocating tenants from the existing space will impact the schedule of the new CTMF facility by 12-18 months, unless capacity is currently available at the NRC Royalmount site.	Greenfield design and construction can start immediately. Greenfield design and construction can start immediately.
	b. The current schedule calls for the appointment of the architect, engineers, construction and validation in December 2020, putting the schedule at least 1 month behind.	It is much easier to proactively manage building a new facility in a fast-track project delivery system that has the design and construction proceeding simultaneously.
	c. The current schedule does not identify specific long-lead building and process-related equipment with a procurement strategy to meet the December 23, 2021 completion putting this date at further risk. Specialized equipment for this type of facility normally has 3-9-month lead times which have been made worse by Covid.	Without the risk of unknowns of an existing facility, more accurate scopes of work can be established for the trade contractors thereby reducing the risk of extras. This is a big factor in cost certainty.
	d. Any remediation for existing building contamination such as	Currently schedule as presented in the previous consultant Report is

Comment	Risk	Opportunity
	mold, asbestos or PCB's, etc. are not included in the current schedule.	not realistic. Construction timeline is tied to the relocation. So, for every day there is a delay in the relocation, there will be a delay in the brownfield project.
	e. Shutdowns within the existing building to tie-in new CTMF mechanical and electrical.	Tie-ins will be coordinated as required.
	f. No structural study has been done prior to feasibility study, any structural changes will delay the project.	
	g. Working in a renovated space, may lead to unintended interruptions.	
	h. Building impairment (fire alarm system) during construction poses a risk to occupants in other areas of the building.	
	i. The basis for the mass balance is unclear as no PFDs have been included.	
	j. Single-use technology vs. stainless steel is unclear. The report tends to switch back and forth between the two options.	
	k. Due to Covid restrictions, construction delays may impact the schedule.	
Budget	a. Several of the items above are not included in the previous consultant budget leaving the overall project cost unknown.	Cost avoidance of the relocation is very significant. The opportunity cost of having the greenfield project on line within 18 months is much more beneficial to NRC than being on line 24-36 months later.
	b. The previous consultant has assumed that existing equipment may be used in the new facility. However, if that equipment is deemed to be not fit for purpose incremental costs will be incurred to purchase new equipment. Furthermore, the consulting firm has provided current market	The cost of a new facility can be fully established from the onset of the project and forecasted accurately.

Comment	Risk	Opportunity
	data for all process equipment required in this new facility. See Appendix 1 for complete equipment list with lead times.	
	c. References are made in the report to Grade A environment and isolator technology. However, neither of this seems priced in the budget. This, as well as the bio-containment strategy, needs to be clarified before a final equipment cost can be established.	
	d. Segregation strategy, bio-containment strategy, and process & personnel flows presented in the report are not optimal. Optimizing these will also impact equipment selection (i.e.: double door vs single door parts washers and autoclaves) and thus cost and schedule.	
Validation	a. Conventional proposed V-model for C&Q is not reflecting current industry practice. All major projects currently prefer a risk- based approach to validation to support an accelerated timeline.	Use ISPE *Commissioning and Qualification Guide 2nd Edition* (2019)

We hope you will find that our review covers all facets of the National Research Council of Canada's request for professional services, and we look forward to working with you and your team.

Thank you again for the opportunity to support National Research Council of Canada.

Appendix 1:

Process Equipment List & Long Lead Times

EQUIPMENT INFORMATION																			BUDGET COST						NOTES
REV.	EQ. NO.	PID No.	MFD No.	EQUIPMENT NAME	DESCRIPTION	Area	ROOM	NEW / EXISTING	MFG.	MODEL NUMBER	SPECIFICATION NO.	BID PACKAGE NO.	DIMENSIONS (L x D x H)	MAX Weight	FURNISHED BY	INSTALLED BY	FIXED OR PORTABLE	BMS or SCADA	UNIT COST	QUANTITY	INSTALLATION FACTOR	TOTAL COST	LEAD TIME (WEEKS ARO)	PRICING SOURCE	
A	-	-	Suite 1	Biosafety Cabinet	Biosafety cabinet for inoculum operations, 3' wide.	Inoculum	TBD	NEW	Baker (Basis)	SG304(Basis)	115353	BP 00105	36" L x 31" W x 62" H	497 lb (shipping)	-	-	FIXED	-	$ 31,428.57	1	-	$ 31,428.57	18	Vendor Budgetary	-
A	-	-	Suite 1	Incubator	Incubator with carbon dioxide and humidity control.	Inoculum	TBD	NEW	ThermoFisher	3950	-	-	33" x 38 " x 80"	500 lb	-	-	FIXED	-	$ 28,150.00	1	-	$ 28,150.00	-	Vendor	Requires carbon dioxide <1 scfm, inlet pressure 15 psig.
A	-	-	Suite 1	Shaker	Shaker to maintain flask agitation in incubator.	Inoculum	TBD	NEW	ThermoFisher	88881101	-	-	11.8" x 14.2" x 3.8"	29 lb	-	-	PORTABLE	-	$ 4,797.14	4	-	$ 19,188.57	-	Vendor	-
A	-	-	Suite 1	Cell Culture Analyzer	ViCell XR cell viability analyzer.	Inoculum	TBD	NEW	Beckman Coulter	ViCell XR	-	-	17.5" x 15" x 16"	25 lb	-	-	PORTABLE	-	$ 85,714.29	1	-	$ 85,714.29	-	Vendor	-
A	-	-	Suite 1	Refrigerator	Clean-room refrigerator for storage of inoclum media bottles.	Inoculum	TBD	NEW	ThermoFisher	TSG2055A	-	-	20.5" x 22.1" x 23"	83 lb	-	-	FIXED	-	$ 3,285.71	1	-	$ 3,285.71	-	Vendor	-
A	-	-	Suite 1	Water Bath	Water bath for cell vial thawing and media bottle warming.	Inoculum	TBD	NEW	ThermoFisher	TSGP02	-	-	9.1" x 7.8" x 9.2"	7 lb	-	-	PORTABLE	-	$ 1,337.14	1	-	$ 1,337.14	-	Vendor	-
A	-	-	Suite 1	Benchtop Scale	Scale for weighing materials in the biosafety cabinet.	Inoculum	TBD	NEW	Ohaus	R71MD6	-	-	11.0" x 16.5" x 4.5"	15 lb	-	-	PORTABLE	-	$ 1,785.71	1	-	$ 1,785.71	-	Vendor	-
A	-	-	Suite 1	25 L rocker SU BRX	Rocker bioreactor for mAb and vaccine products.	Upstream Processing	TBD	NEW	ThermoFisher	F100-2683-002	-	-	32.9" x 28.0" x 19.3"	85 lb	-	-	FIXED	-	$ 85,714.29	1	-	$ 85,714.29	-	Historical	Carbon dioxide usage 0.02 scfm @ 15 psig. Oxygen usage 0.06 scfm @ 15 psig.
A	-	-	Suite 1	50 L rocker SU BRX*	Rocker bioreactor for vaccine products.	Upstream Processing	TBD	NEW	ThermoFisher	F100-2683-002	-	-	32.9" x 28.0" x 19.3"	85 lb	-	-	FIXED	-	$ 85,714.29	1	-	$ 85,714.29	-	Historical	Carbon dioxide usage 0.02 scfm @ 15 psig. Oxygen usage 0.06 scfm @ 15 psig.
A	-	-	Suite 1	50 L SU BRX	Bioreactor for mAb and vaccine products.	Upstream Processing	TBD	NEW	GE/Cytvia	XDR 50	-	-	43" x 43" 78"	642 lb empty	-	-	FIXED	-	$ 292,857.14	1	-	$ 292,857.14	-	Vendor	Carbon dioxide usage 0.18 scfm @ 35 psig. Oxygen usage 0.53 scfm @ 35 psig. Heating can occur either at bioreactor or at TCU. Cooling is external from TCU.
A	-	-	Suite 1	500 L SU BRX	Bioreactor for mAb and vaccine products.	Upstream Processing	TBD	NEW	GE/Cytvia	XDR 500	-	-	43" x 60" x 88"	890 lb empty	-	-	FIXED	-	$ 642,857.14	1	-	$ 642,857.14	-	Vendor	Carbon dioxide usage 0.18 scfm @ 35 psig. Oxygen usage 0.53 scfm @ 35 psig. Heating can occur either at bioreactor or at TCU. Cooling is external from TCU.
A	-	-	Suite 1	Perfusion Filter (25 L BRX)	Perfusion filter and controller for 25 L bioreactor.	Upstream Processing	TBD	NEW	Repligen	suATF2-G02PS/suATF2-STAND/ATFC24 (controller)	-	-	TBD	TBD	-	-	PORTABLE	-	$ 114,285.71	1	-	$ 114,285.71	-	-	Vacuum ~40L/min @ -12.5 psig. Clean steam + condensate around 30 lb/hr if using steamable connection. Consumable, added for reference.
A	-	-	Suite 1	Perfusion Filter (50 L BRX)	Perfusion filter and controller for 50 L bioreactor.	Upstream Processing	TBD	NEW	Repligen	suATF2-G02PS/suATF2-STAND/ATFC24 (controller)	-	-	TBD	TBD	-	-	PORTABLE	-	$ 114,285.71	1	-	$ 114,285.71	-	-	Vacuum ~40L/min @ -12.5 psig. Clean steam + condensate around 30 lb/hr if using steamable connection. Consumable, added for reference.
A	-	-	Suite 1	Perfusion Filter (200 L BRX)	Perfusion filter and controller for 200 L bioreactor.	Upstream Processing	TBD	NEW	Repligen	suATF6-G02PS/suATF6-STAND/ATFC410 v4 (controller)	-	-	12" x 10" x 38"	TBD	-	-	PORTABLE	-	$ 114,285.71	1	-	$ 114,285.71	-	-	Vacuum ~60L/min @ -12.5 psig. Clean steam + condensate around 30 lb/hr if using steamable connection. Consumable, added for reference.
A	-	-	Suite 1	50 L Bioprocess Container (for 25L BRX)	Bioprocess container for 25 L bioreactor filtrate.	Upstream Processing	TBD	NEW	ThermoFisher	SH3065301	-	-	-	-	-	-	PORTABLE	-	$ -	1	-	-	-	-	Consumable, added for reference.
A	-	-	Suite 1	100 L Bioprocess Container (for 50 L BRX)	Bioprocess container for 50 L bioreactor filtrate.	Upstream Processing	TBD	NEW	ThermoFisher	SH3065302	-	-	-	-	-	-	PORTABLE	-	-	1	-	-	-	-	Consumable, added for reference.
A	-	-	Suite 1	500 L Bioprocess Container (for 200 L BRX)	Bioprocess container for 200 L bioreactor filtrate.	Upstream Processing	TBD	NEW	ThermoFisher	SH3065204	-	-	-	-	-	-	PORTABLE	-	-	1	-	-	-	-	Consumable, added for reference.
A	-	-	Suite 1	50 L Bin (for 25 L BRX)	Bin to hold 50 L bioprocess container.	Upstream Processing	TBD	NEW	ThermoFisher	SV5051704	-	-	23.5" x 23"	-	-	-	PORTABLE	-	$ 285.71	1	-	$ 285.71	-	Vendor	-
A	-	-	Suite 1	100 L Bin (for 25 L BRX)	Bin to hold 100 L bioprocess container.	Upstream Processing	TBD	NEW	ThermoFisher	SV5051705	-	-	23.5 x 29.8"	-	-	-	PORTABLE	-	$ 285.71	1	-	$ 285.71	-	Vendor	-
A	-	-	Suite 1	500 L Bin (for 200 L BRX)	Bin to hold 500 L bioprocess container.	Upstream Processing	TBD	NEW	ThermoFisher	SV5016002	-	-	47.5" x 31" x 38.3"	-	-	-	PORTABLE	-	$ 20,000.00	2	-	$ 40,000.00	-	Vendor	-
A	-	-	Suite 1	Peristaltic Pump (25 L)	Peristaltic pump for general use and transfer of cell culture and components.	Upstream Processing	TBD	NEW	Watson Marlow	TBD	463344	-	TBD	TBD	-	-	PORTABLE	-	$ 10,714.29	2	-	$ 21,428.57	-	Past project	-
A	-	-	Suite 1	Peristaltic Pump (50 L)	Peristaltic pump for general use and transfer of cell culture and components.	Upstream Processing	TBD	NEW	Watson Marlow	TBD	463344	-	TBD	TBD	-	-	PORTABLE	-	$ 10,714.29	2	-	$ 21,428.57	-	Past project	-
A	-	-	Suite 1	Peristltic Pump (200 L)	Peristaltic pump for general use and transfer of cell culture and components.	Upstream Processing	TBD	NEW	Watson Marlow	TBD	463344	-	TBD	TBD	-	-	PORTABLE	-	$ 10,714.29	2	-	$ 21,428.57	-	Past project	-
A	-	-	Suite 1	Peristltic Pump (200 L)	Peristaltic pump for general use and transfer of cell culture and components.	Upstream Processing	TBD	NEW	Watson Marlow	TBD	463344	-	TBD	TBD	-	-	PORTABLE	-	$ 10,714.29	2	-	$ 21,428.57	-	Past project	-

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REV.	EQ. NO.	PID No.	MFD No.	EQUIPMENT NAME	DESCRIPTION	Area	ROOM	NEW / EXISTING	MFG.	MODEL NUMBER	SPECIFICATION NO.	BID PACKAGE NO.	DIMENSIONS (L x D x H)	MAX Weight	FURNISHED BY	INSTALLED BY	FIXED OR PORTABLE	BMS or SCADA	UNIT COST	QUANTITY	INSTALLATION FACTOR	TOTAL COST	LEAD TIME (WEEKS ARO)	PRICING SOURCE	
A	-	-	Suite 1	Tube Sealer	Tube sealer to seal lines after completion of use.	Upstream Processing	TBD	NEW	Sartorius	Biosealer TC	-	-	391 mm x 115 mm x 147 mm (15.4" x 4.5" x 5.8")	7 lb	-	-	PORTABLE	-	$ 35,714.29	1	-	$ 35,714.29	-	Historical	-
A	-	-	Suite 1	Tube Welder	Tube welder for aseptic addition of culture or components into bioreactors.	Upstream Processing	TBD	NEW	Sartorius	Biowelder TC	-	-	551 mm x 261 mm x 69 mm (21.7" x 10.3" x 2.7")	35 lb	-	-	PORTABLE	-	$ 38,571.43	1	-	$ 38,571.43	-	Past project	-
A	-	-	Suite 1	Filter Integrity Tester	Filter integrity tester to confirm filter integrity during bioreactor setup.	Upstream Processing	TBD	NEW	Millipore	IT5	433115	-	17"L x 15.4"W x 9.1"H	10.5 kg	-	-	PORTABLE	-	$ 50,000.00	1	-	$ 50,000.00	10	Historical	-
A	-	-	Suite 1	Media Bag Mixer	Media bag mixer for the 200 L production bioreactor. **Hold bin but not mixer**	Upstream Processing	TBD	NEW	Millipore	MXRJ100TLA	-	-	32.0" x 40.7" x 51.6"	550 lb	-	-	PORTABLE*	-	$ 71,428.57	8	-	$ 571,428.57	-	Historical	*Has castors, but ideally shouldn't be moved due to load cell calibrations.
A	-	-	Suite 1	Blood Gas Analyzer	Blood gas analyzer for the offline sampling of pH, glucose, lactate, and electrolytes.	Upstream Processing	TBD	NEW	Beckman Coulter	ViCell MetaFLEX	-	-	9.8" x 11.4" x 18.5"	26 lb	-	-	FIXED	-	$ 57,142.86	1	-	$ 57,142.86	-	Vendor	-
A	-	-	Suite 1	Process Utility Station	Process utility station for 25 L bioreactor.	Upstream Processing	TBD	NEW	CSI (Basis)	N/A	TBD	-	TBD	TBD	-	-	FIXED	-	$ 21,428.57	1	-	$ 21,428.57	14	Historical	-
A	-	-	Suite 1	Process Utility Station	Process utility station for 50 L bioreactor.	Upstream Processing	TBD	NEW	CSI (Basis)	N/A	TBD	-	TBD	TBD	-	-	FIXED	-	$ 21,428.57	1	-	$ 21,428.57	14	Historical	-
A	-	-	Suite 1	Process Utility Station	Process utility stationfor 200 L bioreactor.	Upstream Processing	TBD	NEW	CSI (Basis)	N/A	TBD	-	TBD	TBD	-	-	FIXED	-	$ 21,428.57	1	-	$ 21,428.57	14	Historical	-
A	-	-	Suite 1	Process Utility Station	Process utility station for 200 L bioreactor.	Upstream Processing	TBD	NEW	CSI (Basis)	N/A	TBD	-	TBD	TBD	-	-	FIXED	-	$ 21,428.57	1	-	$ 21,428.57	14	Historical	-
A	-	-	Suite 1	Cell Culture Analyzer	ViCell XR cell viability analyzer.	Upstream Processing	TBD	NEW	Beckman Coulter	ViCell XR	-	-	17.5" x 15" x 16"	25 lb	-	-	PORTABLE	-	$ 85,714.29	1	-	$ 85,714.29	-	Vendor	-
A	-	-	Suite 1	Refrigerator	Refrigerator for temporary storing of components and samples.	Upstream Processing	TBD	NEW	ThermoFisher	TSG205SA	-	-	20.5" x 22.1" x 23"	83 lb	-	-	FIXED	-	$ 3,285.71	1	-	$ 3,285.71	-	Vendor	-
A	-	-	Suite 1	Temperature Control Unit	Temperature control unit (electric heating, chiller), sized for 25/50 L bioreactor.	Upstream Processing	TBD	NEW	Budzar	TBD	-	-	TBD	TBD	-	-	FIXED	-	$ 57,142.86	1	-	$ 57,142.86	18	Historical	-
A	-	-	Suite 1	Temperature Control Unit	Temperature control unit (electric heating, chiller), sized for 200/1000 L bioreactor.	Upstream Processing	TBD	NEW	Budzar	TBD	-	-	TBD	TBD	-	-	FIXED	-	$ 57,142.86	1	-	$ 57,142.86	18	Historical	-
A	-	-	Suite 1	Temperature Control Unit	Temperature control unit (electric heating, chiller), sized for2000 L bioreactor.	Upstream Processing	TBD	NEW	Budzar	TBD	-	-	TBD	TBD	-	-	FIXED	-	$ 57,142.86	1	-	$ 57,142.86	18	Historical	-
A	-	-	Suite 1	Decon Autoclave	Two door pass-thru type, two chemical, sliding doors, SS panels. Pit mounted. Bioseal on Load side.	Upstream Processing	TBD	NEW	Steris	BPS9912	-	-	2820 mm L x 2020 mm D x 1980 mm H	4021 KG	-	-	FIXED	-	$ 571,428.57	1	-	$ 571,428.57	36	Previous Quote	-
A	-	-	Suite 1	Benchtop Scale	Scale for weighing materials added to bioreactors.	Upstream Processing	TBD	NEW	Ohaus	R71MD6	-	-	11.0" x 16.5" x 4.5"	15 lb	-	-	PORTABLE	-	$ 1,785.71	1	-	$ 1,785.71	-	Vendor	-
A	-	-	Suite 1	SU Centrifuge Bioprocess Container	Single use centrifuge for centrifuge wash buffer.	Upstream Processing	TBD	NEW	ThermoFisher	SH3065301	-	-	-	-	-	-	PORTABLE	-	$ -	0	-	-	-	-	Consumable, added for reference.
A	-	-	Suite 1	50 L Bin	Bin to hold 50 L bioprocess container.	Upstream Processing	TBD	NEW	ThermoFisher	SV5051704	-	-	23.5" x 23"	-	-	-	PORTABLE	-	$ 285.71	1	-	$ 285.71	-	-	-
A	-	-	Suite 1	SU Centrifugal Pump	Low-shear single use centrifugal pump for transfer from production bioreactor to centrifuge.	Upstream Processing	TBD	NEW	Levitronix	i100SU: 100-91095 (standard driver system, PLC and Fieldbus tyoe), 100-91078 (irradiated, 1/2" TC connection)	-	-	4.5" x 4.0" x 6"	-	-	-	PORTABLE	-	$ 7,142.86	1	-	$ 7,142.86	-	-	Consumable, added for reference.
A	-	-	Suite 1	SU Depth Filtration System	Encapsulated depth filter system for removal of cell debris.	Upstream Processing	TBD	NEW	Millipore	TBD, based on process requirements	-	-	TBD	-	-	-	PORTABLE	-	$ 428,571.43	TBD	-	$ 428,571.43	-	Historical	-
A	-	-	Suite 1	Peristaltic Pump	Peristaltic pumps to push fluid to and from depth filtration system, and to provide buffer to the single use centrifuge.	Upstream Processing	TBD	NEW	Watson Marlow	TBD	-	-	-	-	-	-	PORTABLE	-	$ 10,714.29	3	-	$ 32,142.86	-	Past project	-
A	-	-	Suite 1	500 L SU Mixer	Single use mixer for storage of clarified harvest material	Upstream Processing	TBD	NEW	Millipore	MXRJ500TLA	-	-	54.8" x 46.8" x 61.6"	920 lb empty, 2011 lb full.	-	-	PORTABLE	-	$ 97,142.86	1	-	$ 97,142.86	-	Past project	
A	-	-	Suite 1	Single Use Turbidity Flow Cell	Single-use turbidity flow cell to monitor harvest process conditions.	Upstream Processing	TBD	NEW	Optek	SUC24, with OPT Holder	-	-	-	-	-	-	PORTABLE	-	-	TBD	-	-	-	-	Quantity TBD based on process requirements.

EQUIPMENT INFORMATION																		BUDGET COST						NOTES
REV.	EQ. NO.	PID No.	MFD No.	EQUIPMENT NAME	DESCRIPTION	Area	ROOM	NEW / EXISTING	MFG.	MODEL NUMBER	SPECIFICATION NO.	BID PACKAGE NO.	DIMENSIONS (L x D x H)	MAX Weight	FURNISHED BY	INSTALLED BY	FIXED OR PORTABLE	BMS or SCADA	UNIT COST	QUANTITY	INSTALLATION FACTOR	TOTAL COST	LEAD TIME (WEEKS ARO)	PRICING SOURCE	
A	-	-	Suite 1	Turbidity Sensor/Lamp	Non-product contact turbidity sensor for use on depth filter skid.	Upstream Processing	TBD	NEW	Optek	TF16-N with C4000 transmitter	-	-	-	-	-	-	Fixed	-	-	TBD	-	-	-	-	Quantity TBD based on process requirements.
A	-	-	Suite 1	Utility Panel	Utility panel for harvest single use mixer.	Upstream Processing	TBD	NEW	CSI (Basis)	N/A	TBD	-	TBD	TBD	-	-	FIXED	-	$ 42,857.14	1	-	$ 42,857.14	14	Historical	-
A	-	-	Suite 1	Chromatography Column 1	First chromatography column.	Downstream Processing	TBD	NEW	GE/Cytvia	AxiChrom 600/300, 29457822, 600 mm diameter	-	-	780 mm x 1180 mm x 2340 mm (30.7" x 46.5" x 92.1")	835 kg (1841 lb) empty.	-	-	PORTABLE	-	$ -	1	-	$ 514,285.71	-	Vendor	-
A	-	-	Suite 1	SU Chromatography Column 1 Controller	Controller skid for first chromatography column.	Downstream Processing	TBD	NEW	GE/Cytvia	29274341	-	-	1280 mm x 1150 mm x 1950 mm (50.4" x 45.3" x 76.8")	-	-	-	PORTABLE	-	$ 878,571.43	1	-	$ 878,571.43	-	Vendor	-
A	-	-	Suite 1	500 L SU Mixer	Single-use mixer for use after first chromatography column.	Downstream Processing	TBD	NEW	Millipore	MXRJ500TLA	-	-	54.8" x 46.8" x 61.6"	920 lb empty, 2011 lb full.	-	-	PORTABLE	-	$ 97,142.86	1	-	$ 97,142.86	-	Past project	-
A	-	-	Suite 1	500 L SU Mixer	Single-use mixer for use after first chromatography column.	Downstream Processing	TBD	NEW	Millipore	MXRJ500TLA	-	-	54.8" x 46.8" x 61.6"	920 lb empty, 2011 lb full.	-	-	PORTABLE	-	$ 97,142.86	1	-	$ 97,142.86	-	Past project	-
A	-	-	Suite 1	Chromatography Column 2	Second chromatography column.	Downstream Processing	TBD	NEW	GE/Cytvia	AxiChrom 600/300, 29457822, 600 mm diameter	-	-	780 mm x 1180 mm x 2340 mm (30.7" x 46.5" x 92.1")	835 kg (1841 lb) empty.	-	-	PORTABLE	-	$ -	1	-	$ 514,285.71	-	Vendor	-
A	-	-	Suite 1	SU Chromatography Column 2 Controller	Controller skid for second chromatography column.	Downstream Processing	TBD	NEW	GE/Cytvia	29274341	-	-	1280 mm x 1150 mm x 1950 mm (50.4" x 45.3" x 76.8")	-	-	-	PORTABLE	-	$ 878,571.43	1	-	$ 878,571.43	-	Vendor	-
A	-	-	Suite 1	500 L SU Mixer	Single-use mixer for use after second chromatography column.	Downstream Processing	TBD	NEW	Millipore	MXRJ500TLA	-	-	54.8" x 46.8" x 61.6"	920 lb empty, 2011 lb full.	-	-	PORTABLE	-	$ 97,142.86	1	-	$ 97,142.86	-	Past project	-
A	-	-	Suite 1	Chromatography Column 3	Third chromatography column.	Downstream Processing	TBD	NEW	GE/Cytvia	AxiChrom 600/300, 29457822, 600 mm diameter	-	-	780 mm x 1180 mm x 2340 mm (30.7" x 46.5" x 92.1")	835 kg (1841 lb) empty.	-	-	PORTABLE	-	$ -	1	-	$ 514,285.71	-	Vendor	-
A	-	-	Suite 1	SU Chromatography Column 3 Controller	Controller skid for third chromatography column.	Downstream Processing	TBD	NEW	GE/Cytvia	29274341	-	-	1280 mm x 1150 mm x 1950 mm (50.4" x 45.3" x 76.8")	-	-	-	PORTABLE	-	$ 878,571.43	1	-	$ 878,571.43	-	Vendor	-
A	-	-	Suite 1	500 L SU Mixer	Single-use mixer for use after third chromatography column.	Downstream Processing	TBD	NEW	Millipore	MXRJ500TLA	-	-	54.8" x 46.8" x 61.6"	920 lb empty, 2011 lb full.	-	-	PORTABLE	-	$ 97,142.86	1	-	$ 97,142.86	-	Past project	-
A	-	-	Suite 1	VF Skid	Single-use viral filtration skid.	Downstream Processing	TBD	NEW	Millipore	VF3 40 LPM	-	-	1631 mm x 800 mm x 1744 mm (64.2" x 31.5" x 68.7")	390 kg (860 lb)	-	-	PORTABLE	-	$ 200,000.00	1	-	$ 200,000.00	-	Past Project	-
A	-	-	Suite 1	100 L SU Mixer*	Single-use mixer for use after second chromatography column, during vaccine processes.	Downstream Processing	TBD	NEW	Millipore	MXRJ100TLA	-	-	-	-	-	-	PORTABLE*	-	$ 71,428.57	1	-	$ 71,428.57	-	Historical	*Has castors, but ideally shouldn't be moved due to load cell calibrations.
A	-	-	Suite 1	SU UF Skid*	Single-use UF skid for use in vaccine processes. **(Delete)**	Downstream Processing	TBD	NEW	GE/Cytvia	AKTA readyflux	-	-	110 cm x 88 cm x 152 cm (43.3" x 34.6" x 59.8")	-	-	-	FIXED	-	$ 750,000.00	1	-	$ 750,000.00	-	Past Project	-
A	-	-	Suite 1	Filter Integrity Tester	Filter integrity tester for various air and liquid filters throughout pre-viral purification process.	Downstream Processing	TBD	NEW	Millipore	IT5	433115	-	17"L x 15.4"W x 9.1"H	10.5 kg	-	-	PORTABLE	-	$ 50,000.00	1	-	$ 50,000.00	10	Historical	-
A	-	-	Suite 1	Peristaltic Pumps	Peristaltic pumps used to aid transfer to and from bags and process equipment in the pre-viral purification process.	Downstream Processing	TBD	NEW	Watson Marlow	TBD	-	-	-	-	-	-	PORTABLE	-	$ 10,714.29	7	-	$ 75,000.00	-	Past project	-
A	-	-	Suite 1	Utility Panels	Utility panels used for use with single use skids and mixers throughout the pre-viral purification process.	Downstream Processing	TBD	NEW	CSI (Basis)	N/A	TBD	-	TBD	TBD	-	-	FIXED	-	$ 42,857.14	4	-	$ 171,428.57	14	Historical	-
A	-	-	Suite 1	Tube Welder	Tube welder for aseptic addition of components or sampling assemblies to single-use systems.	Downstream Processing	TBD	NEW	Sartorius	Biowelder TC	-	-	551 mm x 261 mm x 69 mm (21.7" x 10.3" x 2.7")	35 lb	-	-	PORTABLE	-	$ 38,571.43	1	-	$ 38,571.43	-	Past project	-
A	-	-	Suite 1	Tube Sealer	Tube sealer to seal lines after completion of use.	Downstream Processing	TBD	NEW	Sartorius	Biosealer TC	-	-	391 mm x 115 mm x 147 mm (15.4" x 4.5" x 5.8")	7 lb	-	-	PORTABLE	-	$ 35,714.29	1	-	$ 35,714.29	-	Historical	-
A	-	-	Suite 1	Benchtop pH Meter	pH meter to confirm online pH data.	Downstream Processing	TBD	NEW	ThermoFisher	STARA1117	-	-	9.5" x 7.1" x 4.3"	-	-	-	PORTABLE	-	$ 1,142.86	1	-	$ 1,142.86	-	Vendor	-
A	-	-	Suite 1	Benchtop Conductivity Meter	Conductivity meter to confirm online conductivity data.	Downstream Processing	TBD	NEW	ThermoFisher	STARA1120	-	-	9.5" x 7.1" x 4.3"	-	-	-	PORTABLE	-	$ 1,142.86	1	-	$ 1,142.86	-	Vendor	-

EQUIPMENT INFORMATION																		BUDGET COST						NOTES
REV.	EQ. NO.	PID No.	MFD No.	EQUIPMENT NAME	DESCRIPTION	Area	ROOM	NEW / EXISTING	MFG.	MODEL NUMBER	SPECIFICATION NO.	BID PACKAGE NO.	DIMENSIONS (L x D x H)	MAX Weight	FURNISHED BY	INSTALLED BY	FIXED OR PORTABLE	BMS or SCADA	UNIT COST	QUANTITY	INSTALLATION FACTOR	TOTAL COST	LEAD TIME (WEEKS ARO)	PRICING SOURCE	
A	-	-	Suite 1	Spectrophotometer	Benchtop spectroscopy for confirmation of intermediate product concentration data.	Downstream Processing	TBD	NEW	Repligen/C Technologies	Solo VPE	-	-	10.0" x 10.0" x 15.0"	20 lb	-	-	PORTABLE	-	$ 18,571.43	1	-	$ 18,571.43	-	Past project	-
A	-	-	Suite 1	100 L SUM	Single-use mixer for collection of product post-viral filtration.	Bulk Fill	TBD	NEW	Millipore	MXRJ100TLA	-	-	-	-	-	-	PORTABLE*	-	$ 71,428.57	1	-	$ 71,428.57	-	Historical	*Has castors, but ideally shouldn't be moved due to load cell calibrations.
A	-	-	Suite 1	SU UF Skid	Single-use TFF skid.	Bulk Fill	TBD	NEW	GE/Cytvia	AKTA readyflux	-	-	110 cm x 88 cm x 152 cm (43.3" x 34.6" x 59.8")	-	-	-	FIXED	-	$ 750,000.00	1	-	$ 750,000.00	-	Past Project	-
A	-	-	Suite 1	100 L SUM	Single-use mixer for collection of retentate post-UF.	Bulk Fill	TBD	NEW	Millipore	MXRJ100TLA	-	-	-	-	-	-	PORTABLE*	-	$ 71,428.57	1	-	$ 71,428.57	-	Historical	*Has castors, but ideally shouldn't be moved due to load cell calibrations.
A	-	-	Suite 1	Peristaltic Pumps	Peristaltic pumps used to aid transfer to and from bags and process equipment in the post-viral purification process.	Bulk Fill	TBD	NEW	Watson Marlow	TBD	-	-	-	-	-	-	PORTABLE	-	$ 10,714.29	3	-	$ 32,142.86	-	Past project	-
A	-	-	Suite 1	Filter Integrity Tester	Filter integrity tester for various air and liquid filters throughout post-viral purification process.	Bulk Fill	TBD	NEW	Millipore	IT5	433115	-	17"L x 15.4"W x 9.1"H	10.5 kg	-	-	PORTABLE	-	$ 50,000.00	1	-	$ 50,000.00	10	Historical	-
A	-	-	Suite 1	Tube Sealer	Tube sealer to seal lines after completion of use.	Bulk Fill	TBD	NEW	Sartorius	Biosealer TC	-	-	391 mm x 115 mm x 147 mm (15.4" x 4.5" x 5.8")	7 lb	-	-	PORTABLE	-	$ 35,714.29	1	-	$ 35,714.29	-	Historical	-
A	-	-	Suite 1	Tube Welder	Tube welder for aseptic addition of components or sampling assemblies to single-use systems.	Bulk Fill	TBD	NEW	Sartorius	Biowelder TC	-	-	551 mm x 261 mm x 69 mm (21.7" x 10.3" x 2.7")	35 lb	-	-	PORTABLE	-	$ 38,571.43	1	-	$ 38,571.43	-	Past project	-
A	-	-	Suite 1	Benchtop pH Meter	pH meter to confirm online pH data.	Bulk Fill	TBD	NEW	ThermoFisher	STARA1117	-	-	9.5" x 7.1" x 4.3"	-	-	-	PORTABLE	-	$ 1,142.86	1	-	$ 1,142.86	-	Vendor	-
A	-	-	Suite 1	Benchtop Conductivity Meter	Conductivity meter to confirm online conductivity data.	Bulk Fill	TBD	NEW	ThermoFisher	STARA1120	-	-	9.5" x 7.1" x 4.3"	-	-	-	PORTABLE	-	$ 1,142.86	1	-	$ 1,142.86	-	Vendor	-
A	-	-	Suite 1	Utility Panel	Utility panel used for use with single use skids and mixers throughout the post-viral purification process.	Bulk Fill	TBD	NEW	CSI (Basis)	N/A	TBD	-	TBD	TBD	-	-	FIXED	-	$ 42,857.14	1	-	$ 42,857.14	14	Historical	-
A	-	-	Suite 1	**Biosafety Cabinet**	Laminar flow hood for aseptic bulk fill operations.	Bulk Fill	TBD	NEW	ThermoFisher	51029701	-	-	39.3" x 46.1" x 31.9"	200 lb	-	-	FIXED	-	$ 28,571.43	1	-	$ 28,571.43	-	Historical	-
A	ST	-	-	WFI Generation System	Vapor Compression WFI Still. Feedwater booster pump fed with PUW Water	Utilities	TBD	NEW	MECO	P4500MSSH			138" x 200" x 131"	Aprox. 20,000 lbs	-	-	FIXED	-	$ 642,857.14	1	-	$ 642,857.14	28	Historical	-
A	TK	-	-	WFI Storage Vessel	10,000 L 316LSS, sprayballs, insulated	Utilities	TBD	NEW	Mueller (Basis)	N/A	434523	BP17321	142"L x 144"D x 200"H	Empty: 10,000 lb Full: 31,850 lb.	-	-	FIXED	N/A	$ 128,571.43	1	-	$ 128,571.43	24	Historical	-
A	DST	-	-	WFI Distribution Skid	Centrifugal pump and hx included	Utilities	TBD	NEW	Mueller	N/A	439010	BP17740	120"L x 64"D x 106"H	Empty: 2,360 lb Full: 2,860 lb	-	-	FIXED	-	$ 571,428.57	1	0	$ 571,428.57	32	Previous Quote	-
A	SO	-	-	Primary Softener	Multimedia filtration, Softener, brine tank, booster pump	Utilities	TBD	NEW		N/A	439010	BP17743	TBD	TBD	-	-	FIXED	-	$ 535,714.29	1	-	$ -	26	Historical	-
A	SO	-	-	Secondary softener	Break tank, Carbon bed, softener, brine tank, circulation pump, hot water sanitization	Utilities	TBD	NEW	Meco	N/A	439010	BP17743	TBD	TBD	-	-	FIXED	-	$ 214,285.71	1	-	$ 214,285.71	26	Historical	-
A	CSG	-	-	Clean Steam Generator	Clean Steam Generator 2,000 lb/hr	Utilities	TBD	NEW	Mueller	P7500	439003	BP 17320	50"W x 61.5"D x 126"H	Empty: 5,100 lb Full: XXX lb. Aprox. 5,700 lbs	-	-	FIXED	-	$ 250,000.00	1	-	$ 250,000.00	26	Historical	-
A	TCU	-	-	Process Glycol System	Electric Heating, Chiller, Sized for 200gpm	Utilities	TBD	NEW	Budzar	TBD	424000	BP 17442	180"L x 152"W x 100"H	Empty: 1,850 lb Full: 2,450 lb.	-	-	FIXED	-	$ 428,571.43	1	-	$ 428,571.43	18	Historical	-
A	HEX	-	-	WFI HEX	Packaged In-line cooler, 15LPM	Utilities	TBD	NEW	Spirax Sarco (Basis)	SSC20	421331	-	30"W x 18"D x 40"H	50kg	-	-	FIXED	-	$ 57,142.86	6	-	$ 342,857.14	2	Historical	-
A	SC	-	-	Clean Steam Sample Cooler	End of main	Utilities	TBD	NEW	Spirax Sarco (Basis)	SSC20	421331	-	4"W x 4"D x 18"H	3.1 kg	-	-	FIXED	-	$ 7,428.57	4	-	$ 29,714.29	2	Historical	-
A	BIO	-	-	Biowaste decon System	BSL2 decon 5 gpm at 135ºC (basis)	Utilities	TBD	NEW	Wastech	BioDelta	439016	BP 00102	TBD	TBD	-	-	FIXED	-	$ 571,428.57	1	-	$ 571,428.57	26	Historical	-
A	TK	-	-	Biowaste Tank	Horizontal 10,000L Tank, BSL2 decon 5 gpm at 135ºC (basis)	Utilities	TBD	NEW	Wastech	BioDelta	439016	BP 00102	TBD	TBD	-	-	FIXED	-	$ 171,428.57	1	-	$ 171,428.57	26	Vendor Quote	-
A	AC	-	-	Air compressor	Variable speed, oil free, rotary screw compressor with receiver and dryer	Utilities	TBD	NEW	Atlas	ZR 75 VSD	-	-	82" X 52" X77"	4400 lbs	-	-	FIXED	-	$ 171,428.57	2	-	$ 342,857.14	14	Previous Quote	-
A	HSG	-	-	Humidification steam generator	Single pot boiler for chemical free steam, 1000kg/hr	Utilities	TBD	NEW			TBD	BP-00112	140.5" L x 156" W x 72" H	TBD	-	-	FIXED	-	$ 107,142.86	1	-	$ 107,142.86	20	Historical	-
A	TK	-	-	LN2 Storage Tank(Lease)		Utilities	TBD	NEW			439016	BP 00102	TBD	TBD	-	-	FIXED	-	$ -	1	-	$ -	26	Historical	-
A	TK	-	-	O2 Storage Tank(Lease)		Utilities	TBD	NEW			439016	BP 00102	TBD	TBD	-	-	FIXED	-	$ -	1	-	$ -	26	Historical	-
A	TK	-	-	CO2 Storage Tank(Lease)		Utilities	TBD	NEW			439016	BP 00102	TBD	TBD	-	-	FIXED	-	$ -	1	-	$ -	26	Historical	-