Gemini GNAO/RTC Work Breakdown Structure, 5/21/19

ID	WBS	Task Name	Start	Finish	Work	Duration	Resource Names	Predecessors	Cost
1	**1**	**GNAO/RTC Project**	**Mon 5/20/19**	**Tue 10/1/24**	**1,825.97 wks**	**280.4 wks**			**$6,528,377.93**
2	**1.1**	**Meetings And Milestones**	**Thu 9/5/19**	**Tue 10/1/24**	**40.8 wks**	**264.8 wks**			**$155,846.40**
3	1.1.1	Submit documentation for CoDR	Thu 9/5/19	Thu 9/5/19	0 wks	0.2 wks		4FS-2 wks	$0.00
4	1.1.2	CoDR	Tue 9/17/19	Wed 9/18/19	6.8 wks	0.4 wks	AndersenM_P,BlainC_P,Blank	5FS-2 wks	$24,573.92
5	1.1.3	CoDR concludes, PD commences	Mon 9/30/19	Mon 9/30/19	0 wks	0.2 wks			$0.00
6	1.1.4	Submit documentation for PDR	Wed 5/6/20	Wed 5/6/20	0 wks	0.2 wks		7FS-2 wks	$0.00
7	1.1.5	PDR	Mon 5/18/20	Tue 5/19/20	6.8 wks	0.4 wks	AndersenM_P,BlainC_P,Blank	8FS-2 wks	$24,573.92
8	1.1.6	PDR concludes, CD commences	Fri 5/29/20	Fri 5/29/20	0 wks	0.2 wks			$0.00
9	1.1.7	Submit documentation for CDR	Wed 1/6/21	Wed 1/6/21	0 wks	0.2 wks		10FS-2 wks	$0.00
10	1.1.8	CDR	Mon 1/18/21	Tue 1/19/21	6.8 wks	0.4 wks	AndersenM_C,BlainC_C,Blank	11FS-2 wks	$25,311.04
11	1.1.9	CDR concludes, Build commences	Fri 1/29/21	Fri 1/29/21	0 wks	0.2 wks			$0.00
12	1.1.10	Submit documents for Pre-I&T Review	Thu 9/8/22	Thu 9/8/22	0 wks	0.2 wks		13FS-2 wks	$0.00
13	1.1.11	Pre-I&T Review	Tue 9/20/22	Wed 9/21/22	6.8 wks	0.4 wks	AndersenM_B,BlainC_B,Blank	14FS-2 wks	$26,071.36
14	1.1.12	Pre-I&T Review concludes, I&T commences	Mon 10/3/22	Mon 10/3/22	0 wks	0.2 wks			$0.00
15	1.1.13	Final document review	Wed 3/27/24	Thu 3/28/24	6.8 wks	0.4 wks	AndersenM_I,BlainC_I,BlankA	16FS-1 wk	$27,658.08
16	1.1.14	First Light	Mon 4/1/24	Tue 4/2/24	6.8 wks	0.4 wks	AndersenM_I,BlainC_I,BlankA		$27,658.08
17	1.1.15	Schedule contingency	Wed 4/3/24	Tue 10/1/24	0 wks	26 wks		16	$0.00
18									
19	**1.2**	**Project Management, including non-subsystem-specific SE**	**Mon 6/3/19**	**Mon 3/25/24**	**342.17 wks**	**251.2 wks**			**$1,400,896.67**
20	**1.2.1**	**Project Mannagement (PM), including: project oversight; technical management; schedule, budget, and scope management; procurement and subcontract management; reporting and reviews; and other communications.**	**Mon 6/3/19**	**Mon 3/25/24**	**230.75 wks**	**251.2 wks**			**$982,624.00**
21	**1.2.1.1**	**Conceptual Design**	**Mon 6/3/19**	**Fri 9/27/19**	**21.25 wks**	**17 wks**			**$91,524.60**
22	1.2.1.1.1	Project Management	Mon 6/3/19	Fri 9/27/19	17 wks	17 wks	PalmerD_P		$84,850.40
23	1.2.1.1.2	Project Coordinator	Mon 6/3/19	Fri 9/27/19	4.25 wks	17 wks	BlankA_P[25%]		$6,674.20
24	**1.2.1.2**	**Preliminary Design**	**Tue 10/1/19**	**Fri 5/29/20**	**42.5 wks**	**34.8 wks**		**5**	**$183,049.20**
25	1.2.1.2.1	Project Management	Tue 10/1/19	Mon 5/25/20	25.5 wks	34 wks	PalmerD_P[75%]		$127,275.60
26	1.2.1.2.2	Project Coordinator	Tue 10/1/19	Mon 5/25/20	8.5 wks	34 wks	BlankA_P[25%]		$13,348.40
27	1.2.1.2.3	AOS Subcontract Management	Mon 10/7/19	Fri 5/29/20	8.5 wks	34 wks	BlainC_P[25%]		$42,425.20
28	**1.2.1.3**	**Critical Design**	**Mon 6/1/20**	**Fri 1/22/21**	**42.5 wks**	**34 wks**		**8**	**$188,533.40**
29	1.2.1.3.1	Project Management	Mon 6/1/20	Fri 1/22/21	25.5 wks	34 wks	PalmerD_C[75%]		$131,090.40
30	1.2.1.3.2	Project Coordinator	Mon 6/1/20	Fri 1/22/21	8.5 wks	34 wks	BlankA_C[25%]		$13,746.20
31	1.2.1.3.3	AOS Subcontract Management	Mon 6/1/20	Fri 1/22/21	8.5 wks	34 wks	BlainC_C[25%]		$43,696.80
32	**1.2.1.4**	**Build / Implement**	**Mon 2/1/21**	**Fri 9/23/22**	**86 wks**	**86 wks**		**11**	**$377,359.40**
33	1.2.1.4.1	Project Management	Mon 2/1/21	Fri 9/23/22	43 wks	86 wks	PalmerD_B[50%]		$227,693.60
34	1.2.1.4.2	Project Coordinator	Mon 2/1/21	Fri 9/23/22	21.5 wks	86 wks	BlankA_B[25%]		$35,819.00
35	1.2.1.4.3	AOS Subcontract Management	Mon 2/1/21	Fri 9/23/22	21.5 wks	86 wks	BlainC_B[25%]		$113,846.80
36	**1.2.1.5**	**Integration And Test**	**Tue 10/4/22**	**Mon 3/25/24**	**38.5 wks**	**77 wks**		**14**	**$142,157.40**
37	1.2.1.5.1	Project Management	Tue 10/4/22	Mon 3/25/24	19.25 wks	77 wks	PalmerD_I[25%]		$108,138.80
38	1.2.1.5.2	Project Coordinator	Tue 10/4/22	Mon 3/25/24	19.25 wks	77 wks	BlankA_I[25%]		$34,018.60
39	**1.2.2**	**GNAO/RTC Systems Engineering**	**Mon 6/3/19**	**Mon 3/25/24**	**111.42 wks**	**251.2 wks**			**$418,272.67**
40	**1.2.2.1**	**Conceptual Design**	**Mon 6/3/19**	**Fri 9/27/19**	**8.12 wks**	**17 wks**			**$28,841.67**
41	**1.2.2.1.1**	**Configuration Management**	**Mon 6/3/19**	**Fri 9/27/19**	**1.7 wks**	**17 wks**	**SE1_P[10%]**		**$6,196.84**
42	1.2.2.1.2	Technical team management/coordination	Mon 6/3/19	Fri 9/27/19	1.7 wks	17 wks	ProvostN_P[10%]		$6,196.84
43	1.2.2.1.3	Risk Management	Mon 6/3/19	Fri 9/27/19	1.7 wks	17 wks	ProvostN_P[10%]		$6,196.84
44	1.2.2.1.4	Top level systems architecture definitiion and Conceptual Design Iteration	Mon 6/3/19	Fri 8/9/19	0.51 wks	10 wks	ProvostN_P[5%],RamboldW_F		$1,871.95
45	1.2.2.1.5	External Interface definition and management	Mon 8/12/19	Fri 9/6/19	0.81 wks	4 wks	ProvostN_P[20%],RamboldW_	44	$2,945.32
46	1.2.2.1.6	Generate and manage error budget	Mon 6/3/19	Fri 9/27/19	1.7 wks	17 wks	SivoG_P[10%]		$5,433.88
47	1.2.2.2	Preliminary Design	Tue 10/1/19	Mon 5/25/20	27.2 wks	34 wks		5	$96,002.40
48	1.2.2.2.1	Configuration Management	Tue 10/1/19	Mon 5/25/20	3.4 wks	34 wks	SE1_P[10%]		$12,393.68
49	1.2.2.2.2	Technical team management/coordination	Tue 10/1/19	Mon 5/25/20	3.4 wks	34 wks	ProvostN_P[10%]		$12,393.68
50	1.2.2.2.3	Risk Management	Tue 10/1/19	Mon 5/25/20	3.4 wks	34 wks	ProvostN_P[10%]		$12,393.68
51	1.2.2.2.4	Top level systems architecture refinement	Tue 10/1/19	Mon 5/25/20	10.2 wks	34 wks	ProvostN_P[5%],RamboldW_F		$35,559.92
52	1.2.2.2.5	External Interface refinement and management	Tue 10/1/19	Mon 5/25/20	3.4 wks	34 wks	ProvostN_P[5%],RamboldW_F		$12,393.68
53	1.2.2.2.6	Refine and manage error budget	Tue 10/1/19	Mon 5/25/20	3.4 wks	34 wks	SivoG_P[10%]		$10,867.76
54	1.2.2.3	Critical Design	Mon 6/1/20	Fri 1/22/21	27.2 wks	34 wks		8	$98,880.16
55	1.2.2.3.1	Configuration Management	Mon 6/1/20	Fri 1/22/21	3.4 wks	34 wks	SE1_C[10%]		$12,764.96
56	1.2.2.3.2	Technical team management/coordination	Mon 6/1/20	Fri 1/22/21	3.4 wks	34 wks	ProvostN_C[10%]		$12,764.96
57	1.2.2.3.3	Risk Management	Mon 6/1/20	Fri 1/22/21	3.4 wks	34 wks	ProvostN_C[10%]		$12,764.96
58	1.2.2.3.4	Top level systems architecture refinement	Mon 6/1/20	Fri 1/22/21	10.2 wks	34 wks	ProvostN_C[5%],RamboldW_(		$36,626.16
59	1.2.2.3.5	External Interface refinement and management	Mon 6/1/20	Fri 1/22/21	3.4 wks	34 wks	ProvostN_C[5%],RamboldW_(		$12,764.96
60	1.2.2.3.6	Refine and manage error budget	Mon 6/1/20	Fri 1/22/21	3.4 wks	34 wks	SivoG_C[10%]		$11,194.16
61	1.2.2.4	Build / Implement	Mon 2/1/21	Fri 9/23/22	25.8 wks	86 wks		11	$99,773.76
62	1.2.2.4.1	Configuration Management	Mon 2/1/21	Fri 9/23/22	8.6 wks	86 wks	SE1_B[10%]		$33,257.92
63	1.2.2.4.2	Technical team management/coordination	Mon 2/1/21	Fri 9/23/22	8.6 wks	86 wks	ProvostN_B[10%]		$33,257.92
64	1.2.2.4.3	Risk Management	Mon 2/1/21	Fri 9/23/22	8.6 wks	86 wks	ProvostN_B[10%]		$33,257.92
65	1.2.2.5	Integration and Test (I&T)	Tue 10/4/22	Mon 3/25/24	23.1 wks	77 wks		14	$94,774.68
66	1.2.2.5.1	Configuration Management	Tue 10/4/22	Mon 3/25/24	7.7 wks	77 wks	SE1_I[10%]		$31,591.56
67	1.2.2.5.2	Technical team management/coordination	Tue 10/4/22	Mon 3/25/24	7.7 wks	77 wks	ProvostN_I[10%]		$31,591.56
68	1.2.2.5.3	Risk Management	Tue 10/4/22	Mon 3/25/24	7.7 wks	77 wks	ProvostN_I[10%]		$31,591.56
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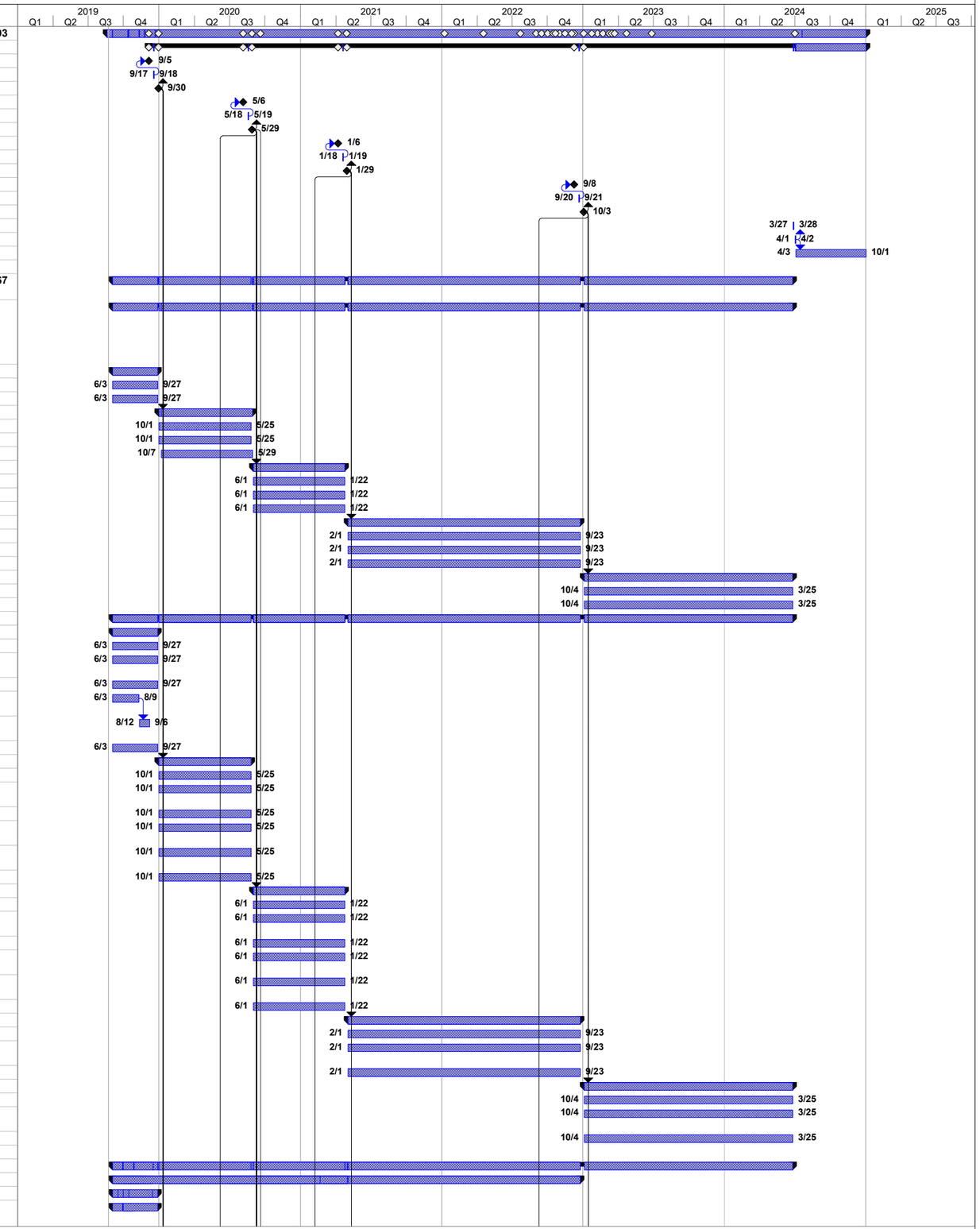
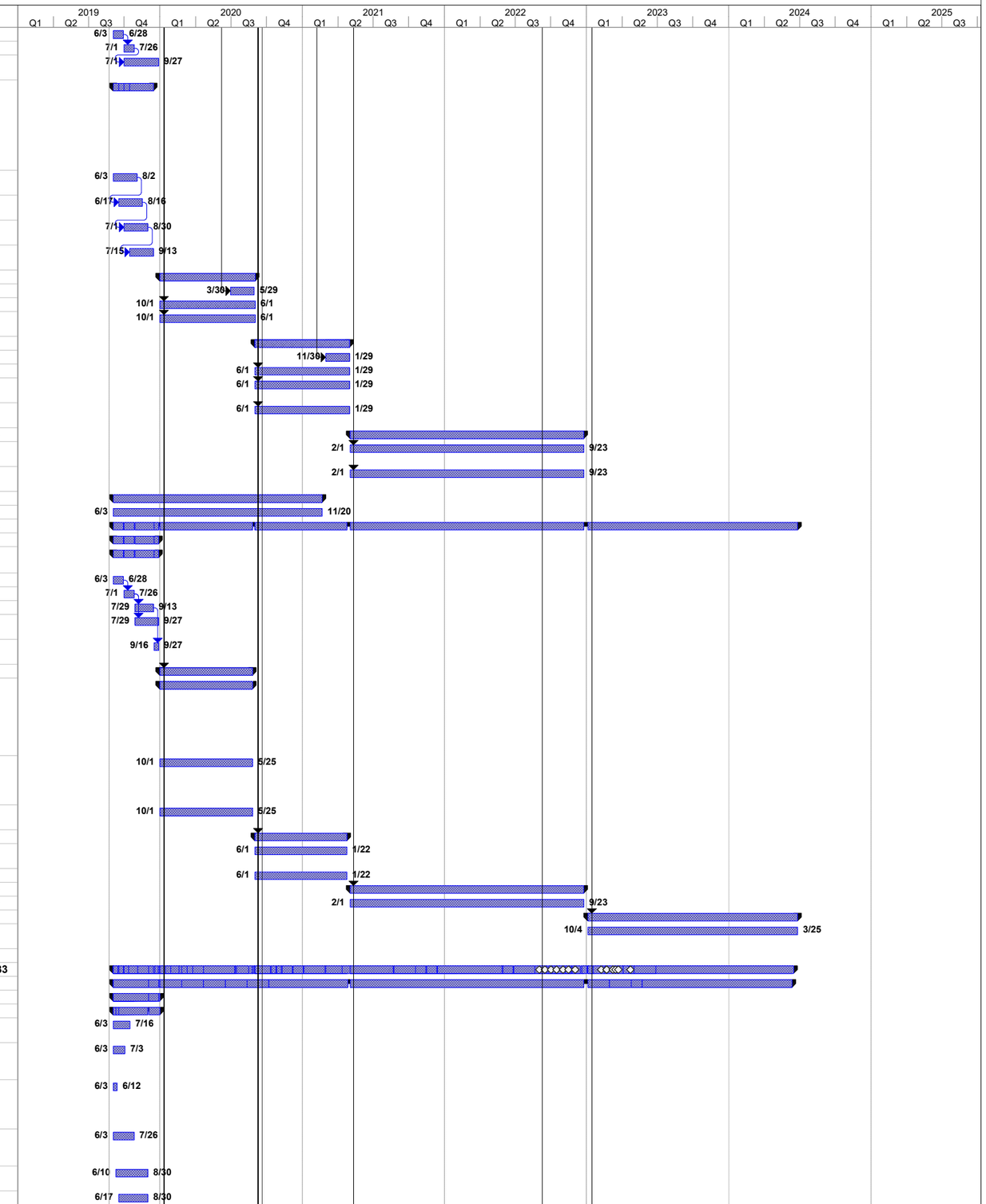
70	**1.3**	**Science, including the AOWG**	**Mon 6/3/19**	**Mon 3/25/24**	**236.6 wks**	**251.2 wks**			**$764,149.36**
71	**1.3.1**	**Science**	**Mon 6/3/19**	**Fri 9/23/22**	**120.8 wks**	**173 wks**			**$405,277.20**
72	1.3.1.1	Conceptual Design	Mon 6/3/19	Fri 9/27/19	16 wks	17 wks			$51,887.24
73	**1.3.1.1.1**	**Prepare science cases and derive scientific requirements**	**Mon 6/3/19**	**Fri 9/27/19**	**2.5 wks**	**17 wks**			**$7,991.00**



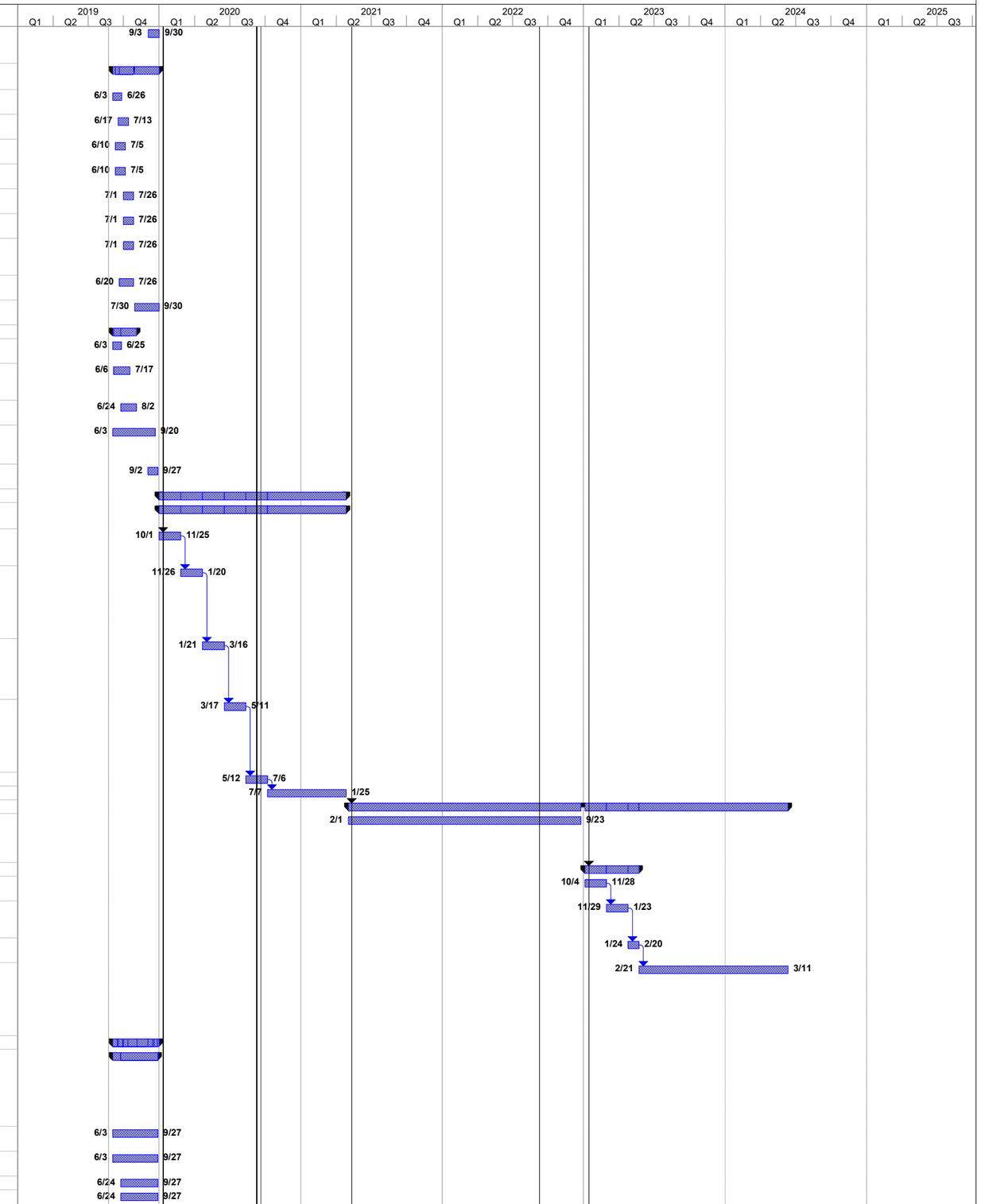
Gemini GNAO/RTC Work Breakdown Structure, 5/21/19

ID	WBS	Task Name	Start	Finish	Work	Duration	Resource Names	Predecessors	Cost
74	1.3.1.1.1.1	Collect science case input	Mon 6/3/19	Fri 6/28/19	0.4 wks	4 wks	AndersenM_P[10%]		$1,278.56
75	1.3.1.1.1.2	Derive science requirements	Mon 7/1/19	Fri 7/26/19	0.8 wks	4 wks	AndersenM_P[20%]	74	$2,557.12
76	1.3.1.1.1.3	Finalize CoDR version of science case document	Mon 7/1/19	Fri 9/27/19	1.3 wks	13 wks	AndersenM_P[10%]	75FS-4 wks	$4,155.32
77	**1.3.1.1.2**	**Prepare Concept of Operations document together with technical team using flowed-down requirements from science team and AO working group. This includes initial strategies for commissioning and acceptance tests. This includes visiting a GeMS run at GS.**	**Mon 6/3/19**	**Fri 9/13/19**	**13.5 wks**	**15 wks**			**$43,896.24**
78	1.3.1.1.2.1	Derive LGS concept of operations together with LGS team	Mon 6/3/19	Fri 8/2/19	3.15 wks	9 wks	ScharwaechterJ_P[15%],Sivo(		$10,396.80
79	1.3.1.1.2.2	Derive AO system concept of operations together with AO team	Mon 6/17/19	Fri 8/16/19	3.15 wks	9 wks	ScharwaechterJ_P[15%],Sivo(	78FS-7 wks	$10,396.80
80	1.3.1.1.2.3	Derive software requirements together with software team	Mon 7/1/19	Fri 8/30/19	3.6 wks	9 wks	ScharwaechterJ_P[15%],Sivo(	79FS-7 wks	$11,898.36
81	1.3.1.1.2.4	Derive science operational concepts together with SOS team	Mon 7/15/19	Fri 9/13/19	3.6 wks	9 wks	ScharwaechterJ_P[15%],Sivo(	80FS-7 wks	$11,204.28
82	1.3.1.2	Preliminary Design	Tue 10/1/19	Mon 6/1/20	21.9 wks	35 wks			$70,001.16
83	1.3.1.2.1	Review/update science cases for PD	Mon 3/30/20	Fri 5/29/20	0.9 wks	9 wks	AndersenM_P[10%]	8FS-9 wks	$2,876.76
84	1.3.1.2.2	Update concepts of operations for PD	Tue 10/1/19	Mon 6/1/20	10.5 wks	35 wks	ScharwaechterJ_P[30%]	5	$33,562.20
85	1.3.1.2.3	Participate in preparing acceptance test plan	Tue 10/1/19	Mon 6/1/20	10.5 wks	35 wks	ScharwaechterJ_P[30%]	5	$33,562.20
86	1.3.1.3	Critical Design	Mon 6/1/20	Fri 1/29/21	25.4 wks	35 wks			$83,626.96
87	1.3.1.3.1	Review/update science cases for CD	Mon 11/30/20	Fri 1/29/21	0.9 wks	9 wks	AndersenM_C[10%]	11FS-9 wks	$2,963.16
88	1.3.1.3.2	Update concepts of operations for CD	Mon 6/1/20	Fri 1/29/21	7 wks	35 wks	ScharwaechterJ_C[20%]	8	$23,046.80
89	1.3.1.3.3	Participate in updating acceptance test plan	Mon 6/1/20	Fri 1/29/21	7 wks	35 wks	ScharwaechterJ_C[20%]	8	$23,046.80
90	1.3.1.3.4	Participate in preparing commissioning plan	Mon 6/1/20	Fri 1/29/21	10.5 wks	35 wks	ScharwaechterJ_C[30%]	8	$34,570.20
91	**1.3.1.4**	**Build / Implement**	**Mon 2/1/21**	**Fri 9/23/22**	**34.4 wks**	**86 wks**			**$116,657.28**
92	1.3.1.4.1	Participate in updating acceptance test plan	Mon 2/1/21	Fri 9/23/22	17.2 wks	86 wks	ScharwaechterJ_B[20%]	11	$58,328.64
93	1.3.1.4.2	Participate in updating commissioning plan	Mon 2/1/21	Fri 9/23/22	17.2 wks	86 wks	ScharwaechterJ_B[20%]	11	$58,328.64
94	1.3.1.5	Integration And Test	Mon 6/3/19	Fri 11/20/20	23.1 wks	77 wks			$83,104.56
95	1.3.1.5.1	Participate in acceptance testing	Mon 6/3/19	Fri 11/20/20	23.1 wks	77 wks	ScharwaechterJ_I[30%]		$83,104.56
96	**1.3.2**	**AO Working Group**	**Mon 6/3/19**	**Mon 3/25/24**	**115.8 wks**	**251.2 wks**			**$358,872.16**
97	**1.3.2.1**	**Conceptual Design**	**Mon 6/3/19**	**Fri 9/27/19**	**8.9 wks**	**17 wks**			**$24,130.88**
98	**1.3.2.1.1**	**Define trade off tasks based on science inputs**	**Mon 6/3/19**	**Fri 9/27/19**	**8.9 wks**	**17 wks**			**$24,130.88**
99	1.3.2.1.1.1	Review science cases drivers	Mon 6/3/19	Fri 6/28/19	0.4 wks	4 wks	SivoG_P[10%]		$1,278.56
100	1.3.2.1.1.2	Participate in defining AO trade offs	Mon 7/1/19	Fri 7/26/19	1.6 wks	4 wks	SivoG_P[20%],MarinE_P[20%	99	$5,338.56
101	1.3.2.1.1.3	Participate in performing AO trade offs	Mon 7/29/19	Fri 9/13/19	0.7 wks	7 wks	SivoG_P[10%]	100	$2,237.48
102	1.3.2.1.1.4	Design and do simulations to support trades and to inform other decisions	Mon 7/29/19	Fri 9/27/19	5.4 wks	9 wks	SivoG_P[10%],CatalaL_P[50%	100	$12,719.16
103	1.3.2.1.1.5	Review/Update GNAO AO documentation	Mon 9/16/19	Fri 9/27/19	0.8 wks	2 wks	SivoG_P[40%]	101	$2,557.12
104	**1.3.2.2**	**Preliminary Design**	**Tue 10/1/19**	**Mon 5/25/20**	**27.2 wks**	**34 wks**		**5**	**$69,785.68**
105	**1.3.2.2.1**	**Review Concept of Operations document together with technical team using flowed-down requirements from science team and AO working group. This includes initial strategies for commissioning and acceptance tests.**	**Tue 10/1/19**	**Mon 5/25/20**	**27.2 wks**	**34 wks**			**$69,785.68**
106	1.3.2.2.1.1	Review/update AO top-level requirements based on science cases for PDR (including consultation with science team)	Tue 10/1/19	Mon 5/25/20	3.4 wks	34 wks	SivoG_P[10%]		$10,867.76
107	1.3.2.2.1.2	Detailed AO simulations adapted to selected PD design	Tue 10/1/19	Mon 5/25/20	23.8 wks	34 wks	SivoG_P[20%],CatalaL_P[50%		$58,917.92
108	**1.3.2.3**	**Critical Design**	**Mon 6/1/20**	**Fri 1/22/21**	**13.6 wks**	**34 wks**		**8**	**$44,776.64**
109	1.3.2.3.1	Review/update AO top-level requiremets based on science cases for CDR	Mon 6/1/20	Fri 1/22/21	3.4 wks	34 wks	SivoG_C[10%]		$11,194.16
110	1.3.2.3.2	PI Support	Mon 6/1/20	Fri 1/22/21	10.2 wks	34 wks	SivoG_C[30%]		$33,582.48
111	1.3.2.4	Build / Implement	Mon 2/1/21	Fri 9/23/22	43 wks	86 wks		11	$145,821.60
112	1.3.2.4.1	PI Support	Mon 2/1/21	Fri 9/23/22	43 wks	86 wks	SivoG_B[50%]		$145,821.60
113	1.3.2.5	Integration and Test (I&T)	Tue 10/4/22	Mon 3/25/24	23.1 wks	77 wks		14	$74,357.36
114	1.3.2.5.1	Participate in bench performance verification	Tue 10/4/22	Mon 3/25/24	23.1 wks	77 wks	SivoG_I[20%],CatalaL_I[10%]		$74,357.36
115									
116	**1.4**	**Laser Guide Star Subsystem (LGS)**	**Mon 6/3/19**	**Fri 3/15/24**	**667.21 wks**	**250 wks**			**$2,330,311.33**
117	**1.4.1**	**LGS Systems Engineering**	**Mon 6/3/19**	**Mon 3/11/24**	**209.92 wks**	**249.2 wks**			**$768,428.62**
118	**1.4.1.1**	**Conceptual Design**	**Mon 6/3/19**	**Mon 9/30/19**	**42.62 wks**	**17.2 wks**			**$149,480.06**
119	**1.4.1.1.1**	**LGS Subsystem requirements definition**	**Mon 6/3/19**	**Mon 9/30/19**	**10.52 wks**	**17.2 wks**			**$38,016.96**
120	1.4.1.1.1.1	Generate LGS Top Level Functional Flow Break Down	Mon 6/3/19	Tue 7/16/19	2.08 wks	6.25 wks	BassettJ_P[20%],RamboldW_		$7,488.92
121	1.4.1.1.1.2	Flow Top Level Requirements to LGS from top level science Requirements (First Draft)	Mon 6/3/19	Wed 7/3/19	1.5 wks	4.5 wks	BassettJ_P[20%],RamboldW_		$5,392.02
122	1.4.1.1.1.3	Generate LGS Functional Requirements and compare against existing GN and GS LGS requirements (First Draft)	Mon 6/3/19	Wed 6/12/19	0.4 wks	1.6 wks	BassettJ_P[20%],RamboldW_		$1,444.61
123	1.4.1.1.1.4	Update Requirements based on Interface Definition, Conops, Trade Study Results etc, Add rationale	Mon 6/3/19	Fri 7/26/19	1.2 wks	8 wks	BassettJ_P[15%]		$4,374.24
124	1.4.1.1.1.5	Generate LGS Verification Plan for each Requirement and fill out VCRM	Mon 6/10/19	Fri 8/30/19	3.84 wks	12 wks	BassettJ_P[20%],RamboldW_		$13,849.38
125	1.4.1.1.1.6	Input LGS Requirements and Verification Methods into DOORS	Mon 6/17/19	Fri 8/30/19	1.1 wks	11 wks	BassettJ_P[10%]		$4,009.72



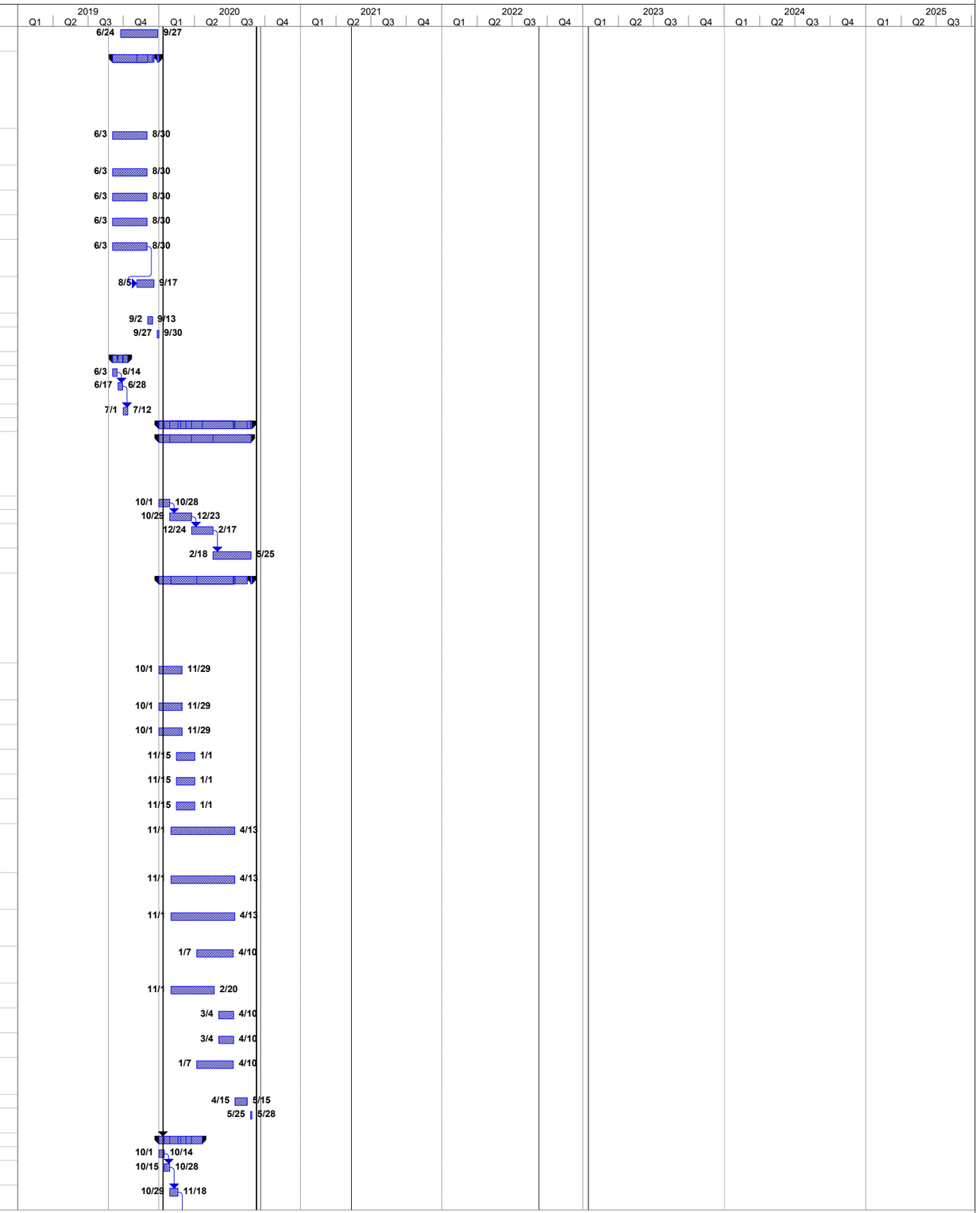
Gemini GNAO/RTC Work Breakdown Structure, 5/21/19

ID	WBS	Task Name	Start	Finish	Work	Duration	Resource Names	Predecessors	Cost
126	1.4.1.1.1.7	Finalize Export LGS Subsystem Requirements Document with VCRM for CoDR	Tue 9/3/19	Mon 9/30/19	0.4 wks	4 wks	BassettJ_P[10%]		$1,458.08
127	**1.4.1.1.2**	**Generate LGS Interface requirements definition**	**Mon 6/3/19**	**Mon 9/30/19**	**16.39 wks**	**17.2 wks**			**$56,981.14**
128	1.4.1.1.2.1	Define LGSF Functional External Interfaces	Mon 6/3/19	Wed 6/26/19	2.44 wks	3.48 wks	ProvostN_P[10%],BassettJ_P[		$8,543.23
129	1.4.1.1.2.2	Generate LGS Interface Control Document for LGS - RTC First Draft	Mon 6/17/19	Sat 7/13/19	1.8 wks	4 wks	ProvostN_P[5%],RamboldW_F		$6,179.92
130	1.4.1.1.2.3	Generate LGS Interface Control Document for LGS - TLC First Draft	Mon 6/10/19	Fri 7/5/19	1.8 wks	4 wks	ProvostN_P[5%],RamboldW_F		$6,179.92
131	1.4.1.1.2.4	Generate LGS Interface Control Document for LGS -TCC First Draft	Mon 6/10/19	Fri 7/5/19	1.8 wks	4 wks	ProvostN_P[5%],RamboldW_F		$6,179.92
132	1.4.1.1.2.5	Update, Review Electrical Interface Requirements	Mon 7/1/19	Fri 7/26/19	0.8 wks	4 wks	ProvostN_P[5%],MarinE_P[5%		$2,815.12
133	1.4.1.1.2.6	Update, Review Mechancial Interface Requirements	Mon 7/1/19	Fri 7/26/19	1 wk	4 wks	ProvostN_P[5%],MarinE_P[5%		$3,510.48
134	1.4.1.1.2.7	Update, Review Service Requirements, including plumbing for Laser Heat Exchanger (LHX)	Mon 7/1/19	Fri 7/26/19	1 wk	4 wks	ProvostN_P[5%],MarinE_P[5%		$3,510.48
135	1.4.1.1.2.8	Update, ReviewEnvironmental Requiremnts	Thu 6/20/19	Fri 7/26/19	0.8 wks	5.33 wks	ProvostN_P[5%],MarinE_P[5%		$2,826.35
136	1.4.1.1.2.9	Review, Update, Finalize CoDR Drafts of ICDs	Tue 7/30/19	Mon 9/30/19	4.95 wks	9 wks	ProvostN_P[10%],RamboldW_		$17,235.72
137	**1.4.1.1.3**	**Generate LGS ConOps**	**Mon 6/3/19**	**Fri 8/2/19**	**7.31 wks**	**9 wks**			**$25,119.24**
138	1.4.1.1.3.1	Describe GeMS LGSF System and Reason for Change	Mon 6/3/19	Tue 6/25/19	1.61 wks	3.25 wks	ProvostN_P[5%],RamboldW_F		$5,536.68
139	1.4.1.1.3.2	Describe GNAO LGSF System Operation, including safety system, diagnostics, alignment, etc. (1st Draft)	Thu 6/6/19	Wed 7/17/19	3.3 wks	6 wks	ProvostN_P[5%],RamboldW_F		$11,355.84
140	1.4.1.1.3.3	Review, Update LGSF Conops, incorporate into GNAO conops	Mon 6/24/19	Fri 8/2/19	2.4 wks	6 wks	ProvostN_P[5%],RamboldW_F		$8,226.72
141	**1.4.1.1.4**	**Lead and participate in design trades, particularly the # of LLTs, lasers, and configuration**	**Mon 6/3/19**	**Fri 9/20/19**	**8 wks**	**16 wks**	**BassettJ_P[20%],MarinE_P[2**		**$27,904.64**
142	1.4.1.1.5	Review and provide input on LGS documentation package	Mon 9/2/19	Fri 9/27/19	0.4 wks	4 wks	BassettJ_P[10%]		$1,458.08
143	**1.4.1.2**	**Preliminary and Critical Design**	**Tue 10/1/19**	**Mon 1/25/21**	**60.3 wks**	**69 wks**			**$210,741.36**
144	**1.4.1.2.1**	**LGS Design Systems Engineering and Oversight**	**Tue 10/1/19**	**Mon 1/25/21**	**60.3 wks**	**69 wks**			**$210,741.36**
145	1.4.1.2.1.1	Continue to Refine Functional Analysis, LGS Requirements, andConops	Tue 10/1/19	Mon 11/25/19	8 wks	8 wks	MarinE_P[50%],CavedoniC_P	5	$27,837.12
146	1.4.1.2.1.2	Define the Physical Architecture (or Product Breakedown Structure) of LGS, by decomposition of the Functional Architecture, defined from Functional Analysis and Allocation, and LGS decomposition processes.	Tue 11/26/19	Mon 1/20/20	8 wks	8 wks	MarinE_P[50%],CavedoniC_P	145	$27,837.12
147	1.4.1.2.1.3	Define Design Solution of the Physical Architecture that satisfy the ConOps and the de-composed (flowed down, derived and allocated) set of subsystem requirements.	Tue 1/21/20	Mon 3/16/20	8 wks	8 wks	MarinE_P[50%],CavedoniC_P	146	$27,837.12
148	1.4.1.2.1.4	Decompose requirements to component level, generate low level specifications	Tue 3/17/20	Mon 5/11/20	8 wks	8 wks	MarinE_P[50%],CavedoniC_P	147	$27,837.12
149	1.4.1.2.1.5	Manage interfaces and maintain ICDs	Tue 5/12/20	Mon 7/6/20	8 wks	8 wks	MarinE_P[50%],CavedoniC_P	148	$27,837.12
150	1.4.1.2.1.6	Provide SE/WPM oversight	Tue 7/7/20	Mon 1/25/21	20.3 wks	29 wks	BassettJ_P[20%],MarinE_P[50	149	$71,555.76
151	**1.4.1.3**	**Build and Integration and Testing (I&T)**	**Mon 2/1/21**	**Mon 3/11/24**	**107 wks**	**162.2 wks**		**11**	**$408,207.20**
152	1.4.1.3.1	LGS Fabrication Systems Engineering and Oversight, including change control, interface management, acceptance testing review and oversight, etc.	Mon 2/1/21	Fri 9/23/22	64.5 wks	86 wks	MarinE_B[50%],BassettJ_B[25		$241,763.20
153	**1.4.1.3.2**	**LGS Verification**	**Tue 10/4/22**	**Mon 2/20/23**	**15 wks**	**20 wks**		**14**	**$56,224.00**
154	1.4.1.3.2.1	Generate detailed LGS acceptance plan and procedure	Tue 10/4/22	Mon 11/28/22	6 wks	8 wks	MarinE_B[50%],BassettJ_B[25		$22,489.60
155	1.4.1.3.2.2	Participate in LGS Acceptance testing, including all verification tests and analyses	Tue 11/29/22	Mon 1/23/23	6 wks	8 wks	MarinE_B[50%],BassettJ_B[25	154	$22,489.60
156	1.4.1.3.2.3	Review and approve Acceptance Test results	Tue 1/24/23	Mon 2/20/23	3 wks	4 wks	MarinE_B[50%],BassettJ_B[25	155	$11,244.80
157	1.4.1.3.3	Support LGS Integration and Test, including development of integration test plan, implementing plan, lead anomaly resolution, lead interface management, perform tests, review and document results	Tue 2/21/23	Mon 3/11/24	27.5 wks	55 wks	MarinE_I[25%],BassettJ_I[25%	156	$110,220.00
158	**1.4.2**	**Conceptual Design**	**Mon 6/3/19**	**Mon 9/30/19**	**35.9 wks**	**17.2 wks**			**$124,200.32**
159	**1.4.2.1**	**Provide CoD of BTO layout for competing LGSF options. Provide optical performance, pricing difference, and fabrication comparison for consideration. Demonstrate that different designs can meet the project performance requirements.**	**Mon 6/3/19**	**Fri 9/27/19**	**7.62 wks**	**17 wks**			**$26,493.22**
160	1.4.2.1.1	Define functional optical requirements for propsed LGSF options	Mon 6/3/19	Fri 9/27/19	1.36 wks	17 wks	SchneiderT_P[5%],CavedoniC		$4,728.45
161	1.4.2.1.2	Define functional opto-mechanical requirements for propsed LGSF options	Mon 6/3/19	Fri 9/27/19	1.36 wks	17 wks	SchneiderT_P[5%],CavedoniC		$4,728.45
162	1.4.2.1.3	Prepare conceptual optical design	Mon 6/24/19	Fri 9/27/19	1.4 wks	14 wks	SchneiderT_P[10%]		$4,867.52
163	1.4.2.1.4	Prepare conceptual opto-mechanical layout	Mon 6/24/19	Fri 9/27/19	2.1 wks	14 wks	SchneiderT_P[10%],Cavedoni		$7,301.28



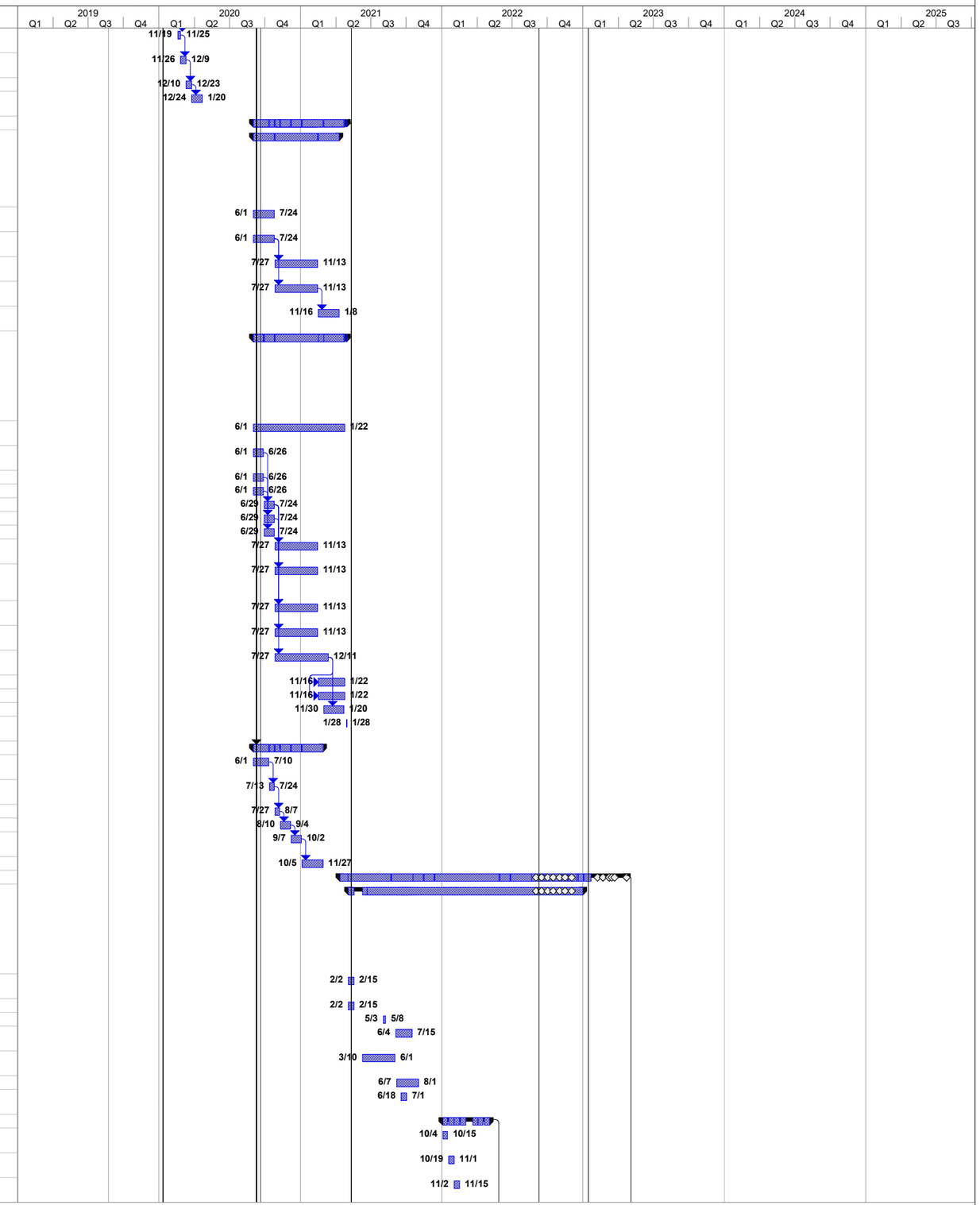
Gemini GNAO/RTC Work Breakdown Structure, 5/21/19

ID	WBS	Task Name	Start	Finish	Work	Duration	Resource Names	Predecessors	Cost
164	1.4.2.1.5	Prepare cost and scheduld estimates for proposed LGSF options	Mon 6/24/19	Fri 9/27/19	1.4 wks	14 wks	SchneiderT_P[10%]		$4,867.52
165	**1.4.2.2**	**Prepare MEP (Mechanical, Electrical, and Plumbing) Deliverable for CoD including 3-d mechanical layouts, mechanical balancing plans, mechanical mounting plans, electrical power plans and plumbing service plans.**	**Mon 6/3/19**	**Mon 9/30/19**	**24.28 wks**	**17.2 wks**			**$84,416.70**
166	1.4.2.2.1	Prepare conceptual 3-d layouts for the proposed LGSF option(s) (including necessary LLTs, LHs, ECs, BTOs & LHXs)	Mon 6/3/19	Fri 8/30/19	9.1 wks	13 wks	CavedoniC_P[10%],KangS_P[		$31,638.88
167	1.4.2.2.2	Prepare conceptual balancing plans for the proposed LGSF option(s)	Mon 6/3/19	Fri 8/30/19	1.3 wks	13 wks	CavedoniC_P[10%]		$4,519.84
168	1.4.2.2.3	Prepare conceptual mounting schemes for the proposed LGSF option(s)	Mon 6/3/19	Fri 8/30/19	7.8 wks	13 wks	CavedoniC_P[10%],KangS_P[		$27,119.04
169	1.4.2.2.4	Prepare conceptual plumbing service plans for proposed LGSF option(s)	Mon 6/3/19	Fri 8/30/19	1.3 wks	13 wks	CavedoniC_P[10%]		$4,519.84
170	1.4.2.2.5	Prepare conceptual electrical power service plans for the proposed LGSF option(s)	Mon 6/3/19	Fri 8/30/19	1.3 wks	13 wks	KarewiczS_P[10%]		$4,519.84
171	1.4.2.2.6	Prepare conceptual MEP cost and schedule estimates for the proposed LGSF option(s)	Mon 8/5/19	Tue 9/17/19	1.28 wks	6.4 wks	CavedoniC_P[10%],KarewiczS	170FS-4 wks	$4,450.30
172	1.4.2.2.7	Prepare CoD MEP Documents	Mon 9/2/19	Fri 9/13/19	1.2 wks	2 wks	CavedoniC_P[10%],KangS_P[		$4,172.16
173	1.4.2.2.8	Review and addressMEP CoD Comments, Concerns & Questions	Fri 9/27/19	Mon 9/30/19	1 wk	0.4 wks	CavedoniC_P,KangS_P,Karew		$3,476.80
174	**1.4.2.3**	**Control Computer Software**	**Mon 6/3/19**	**Fri 7/12/19**	**4 wks**	**6 wks**			**$13,290.40**
175	1.4.2.3.1	Refine laser to LIS electronics interface	Mon 6/3/19	Fri 6/14/19	1 wk	2 wks	KarewiczS_P[50%]		$3,476.80
176	1.4.2.3.2	Define LIS changes to support multiple lasers	Mon 6/17/19	Fri 6/28/19	2 wks	2 wks	EbbersA_P[50%],KarewiczS_F	175	$6,645.20
177	1.4.2.3.3	Define motor control options for BIM/BTO	Mon 7/1/19	Fri 7/12/19	1 wk	2 wks	EbbersA_P[50%]	176	$3,168.40
178	1.4.3	Preliminary Design	Tue 10/1/19	Thu 5/28/20	65.06 wks	34.5 wks			$224,613.82
179	**1.4.3.1**	**Provide preliminary optical design concept for LGSF units that include Zemax optical design model of BTO, 3-D mechanical model layout of BTO, initial build and alignment plan, and cost analysis.**	**Tue 10/1/19**	**Mon 5/25/20**	**16.7 wks**	**34 wks**			**$58,062.56**
180	1.4.3.1.1	Define full optical requirements for LGSF	Tue 10/1/19	Mon 10/28/19	2 wks	4 wks	SchneiderT_P[50%]		$6,953.60
181	1.4.3.1.2	Prepare preliminary optical design	Tue 10/29/19	Mon 12/23/19	2 wks	8 wks	SchneiderT_P[25%]	180	$6,953.60
182	1.4.3.1.3	Prepare preliminary opto-mechanical design layout	Tue 12/24/19	Mon 2/17/20	3.6 wks	8 wks	SchneiderT_P[25%],Cavedoni	181	$12,516.48
183	1.4.3.1.4	Prepare preliminary design for BTO enclosure	Tue 2/18/20	Mon 5/25/20	9.1 wks	14 wks	SchneiderT_P[20%],Cavedoni	182	$31,638.88
184	**1.4.3.2**	**Prepare MEP Deliverable for PD including 3-d mechanical layouts, mechanical assembly drawings, mechanical balancing plans and balancing hardware assembly drawings, mechanical mounting assembly drawings, electrical power plans and plumbing service plans.**	**Tue 10/1/19**	**Thu 5/28/20**	**35.35 wks**	**34.5 wks**			**$122,922.26**
185	1.4.3.2.1	Refine mechancial functional requirements for down selected LGSF option	Tue 10/1/19	Fri 11/29/19	1.74 wks	8.7 wks	CavedoniC_P[20%]		$6,049.63
186	1.4.3.2.2	Refine electrical functional requirements for down selected LGSF option	Tue 10/1/19	Fri 11/29/19	1.74 wks	8.7 wks	KarewiczS_P[20%]		$6,049.63
187	1.4.3.2.3	Refine plumbing functional requirements for down selected LGSF option	Tue 10/1/19	Fri 11/29/19	1.74 wks	8.7 wks	CavedoniC_P[20%]		$6,049.63
188	1.4.3.2.4	Define mechanical ICDs for down selected LGSF option	Fri 11/15/19	Wed 1/1/20	2.68 wks	6.7 wks	CavedoniC_P[20%],KangS_P[		$9,317.82
189	1.4.3.2.5	Define electrical ICDs for down selected LGSF option	Fri 11/15/19	Wed 1/1/20	0.67 wks	6.7 wks	KarewiczS_P[10%]		$2,329.46
190	1.4.3.2.6	Define plumbing ICDs for down selected LGSF option	Fri 11/15/19	Wed 1/1/20	0.67 wks	6.7 wks	CavedoniC_P[10%]		$2,329.46
191	1.4.3.2.7	Prepare preliminary mechanical layouts for down selected LGSF hardware (including necessary LLTs, LHs, ECs, BTOs & LHXs)	Fri 11/1/19	Mon 4/13/20	9.32 wks	23.3 wks	CavedoniC_P[10%],KangS_P[		$32,403.78
192	1.4.3.2.8	Prepare preliminary mechanical balancing plan and sequence of balancing for down selected LGSF	Fri 11/1/19	Mon 4/13/20	2.33 wks	23.3 wks	CavedoniC_P[10%]		$8,100.94
193	1.4.3.2.9	Prepare preliminary mechanical mounting assembly drawings for down selected LGSF	Fri 11/1/19	Mon 4/13/20	4.96 wks	23.3 wks	CavedoniC_P[20%],KangS_P[		$17,244.93
194	1.4.3.2.10	Prepare preliminary electrical power one-line diagrams for down selected LGSF	Tue 1/7/20	Fri 4/10/20	1.37 wks	13.7 wks	KarewiczS_P[10%]		$4,763.22
195	1.4.3.2.11	Prepare preliminary plumbing schematic for down selected LGSF	Fri 11/1/19	Thu 2/20/20	3.2 wks	16 wks	CavedoniC_P[10%],KangS_P[		$11,125.76
196	1.4.3.2.12	Prepare preliminary MEP cost estimates for down selected LGSF	Wed 3/4/20	Fri 4/10/20	1.12 wks	5.6 wks	CavedoniC_P[10%],KarewiczS		$3,894.02
197	1.4.3.2.13	Prepare preliminary MEP schedule estimates for down selected LGSF	Wed 3/4/20	Fri 4/10/20	1.12 wks	5.6 wks	CavedoniC_P[10%],KarewiczS		$3,894.02
198	1.4.3.2.14	Prepare technical specifications, solicit quotes and receive quotes for long-lead item(s) - LHX	Tue 1/7/20	Fri 4/10/20	1.09 wks	13.7 wks	CavedoniC_P[10%],KangS_P[		$3,772.33
199	1.4.3.2.15	Prepare PD MEP Documents	Wed 4/15/20	Fri 5/15/20	0.86 wks	4.6 wks	CavedoniC_P[50%],KangS_P[		$2,990.05
200	1.4.3.2.16	Review and address PD MEP Comments, Concerns & Questions	Mon 5/25/20	Thu 5/28/20	0.75 wks	0.7 wks	CavedoniC_P,KangS_P,Karew		$2,607.60
201	**1.4.3.3**	**Control Computer Software**	**Tue 10/1/19**	**Mon 1/20/20**	**13 wks**	**16 wks**		**5**	**$43,629.00**
202	1.4.3.3.1	Analyze all I/O needs	Tue 10/1/19	Mon 10/14/19	1 wk	2 wks	KarewiczS_P[50%]		$3,476.80
203	1.4.3.3.2	Choose Motor Control solution for BIM/BTO	Tue 10/15/19	Mon 10/28/19	2 wks	2 wks	EbbersA_P[50%],SchneiderT_	202	$6,645.20
204	1.4.3.3.3	Define BTO control architecture and functions.	Tue 10/29/19	Mon 11/18/19	3 wks	3 wks	EbbersA_P[50%],RamboldW_	203	$10,220.40



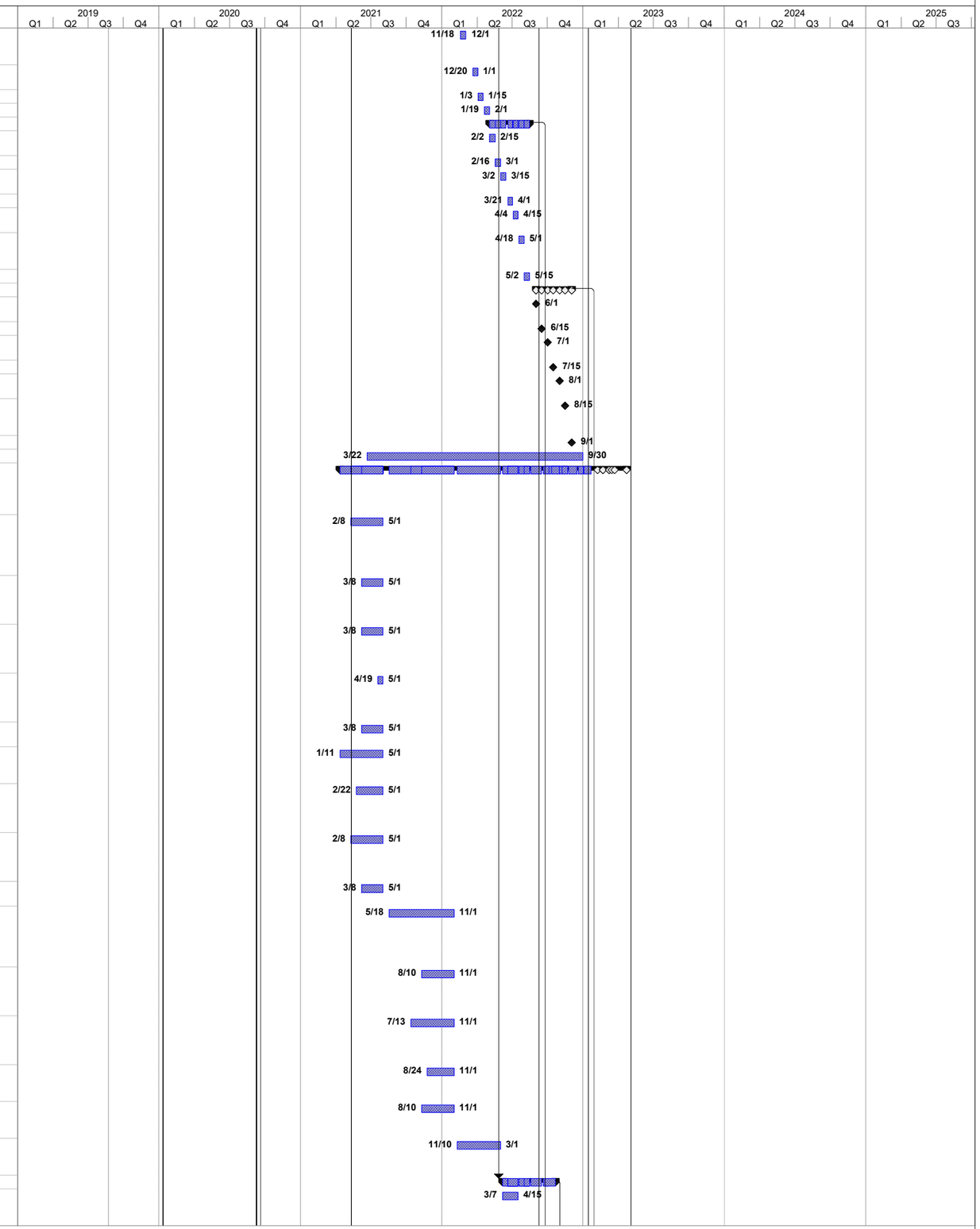
Gemini GNAO/RTC Work Breakdown Structure, 5/21/19

ID	WBS	Task Name	Start	Finish	Work	Duration	Resource Names	Predecessors	Cost
205	1.4.3.3.4	Define interface/control functions for new heat exchanger	Tue 11/19/19	Mon 11/25/19	1 wk	1 wk	EbbersA_P[50%],KarewiczS_F	204	$3,322.60
206	1.4.3.3.5	Review current Toptica EPICS laser control solution	Tue 11/26/19	Mon 12/9/19	1 wk	2 wks	EbbersA_P[50%]	205	$3,168.40
207	1.4.3.3.6	Define fast steering mirror (FSM) control	Tue 12/10/19	Mon 12/23/19	1 wk	2 wks	EbbersA_P[50%]	206	$3,168.40
208	1.4.3.3.7	Define contents of consolidated Laser Control Console	Tue 12/24/19	Mon 1/20/20	4 wks	4 wks	EbbersA_P[50%],RamboldW_	207	$13,627.20
209	1.4.4	Critical Design	Mon 6/1/20	Thu 1/28/21	87.21 wks	34.7 wks			$309,399.89
210	**1.4.4.1**	**Provide finalized optical design and analysis for LGSF units. Provide finalized 3-D mechanical model layout as well as schematic drawings for all necessary parts. Provide electrical diagram for all electronic parts. Provide parts list and final prices.**	**Mon 6/1/20**	**Fri 1/8/21**	**23.12 wks**	**32 wks**			**$82,127.26**
211	1.4.4.1.1	Prepare comprehensive optical layout and analysis	Mon 6/1/20	Fri 7/24/20	2 wks	8 wks	SchneiderT_C[25%]		$7,162.40
212	1.4.4.1.2	Prepare finalized opto-mechanical parts list	Mon 6/1/20	Fri 7/24/20	3.6 wks	8 wks	SchneiderT_C[25%],Cavedoni		$12,892.32
213	1.4.4.1.3	Prepare 3-D model of BTO optical bench and enclosure	Mon 7/27/20	Fri 11/13/20	7.2 wks	16 wks	SchneiderT_C[20%],Cavedoni	212	$25,784.64
214	1.4.4.1.4	Prepare electrical diagram for opto-electronic parts	Mon 7/27/20	Fri 11/13/20	3.52 wks	16 wks	SchneiderT_C[2%],KarewiczS	212	$12,605.82
215	1.4.4.1.5	Prepare build, integration, and testing plans for LGSF units	Mon 11/16/20	Fri 1/8/21	6.8 wks	8 wks	SchneiderT_C[50%],Cavedoni	214	$23,682.08
216	**1.4.4.2**	**Prep MEP Delivs for CD including 3-d mech layouts, assem & fab drawings, mech balancing plans & HW assem & fab drawings, mech mounting plans, assem & fab drawings, electrical power plans install drawings & plumb service plans & install & spec procures**	**Mon 6/1/20**	**Thu 1/28/21**	**44.29 wks**	**34.7 wks**			**$158,611.35**
217	1.4.4.2.1	Release and track purchase order(s) for agreed long lead MEP items (LHX)	Mon 6/1/20	Fri 1/22/21	3.4 wks	34 wks	CavedoniC_C[10%]		$12,176.08
218	1.4.4.2.2	Refine mechanical functional requirements	Mon 6/1/20	Fri 6/26/20	0.8 wks	4 wks	CavedoniC_C[10%],KangS_C[		$2,864.96
219	1.4.4.2.3	Refine electrical functional requirements	Mon 6/1/20	Fri 6/26/20	0.4 wks	4 wks	KarewiczS_C[10%]		$1,432.48
220	1.4.4.2.4	Refine plumbing functional requirements	Mon 6/1/20	Fri 6/26/20	0.8 wks	4 wks	CavedoniC_C[20%]		$2,864.96
221	1.4.4.2.5	Refine mechanical ICDs	Mon 6/29/20	Fri 7/24/20	1.6 wks	4 wks	CavedoniC_C[20%],KangS_C[	218	$5,729.92
222	1.4.4.2.6	Refine electrical ICDs	Mon 6/29/20	Fri 7/24/20	0.4 wks	4 wks	KarewiczS_C[10%]	219	$1,432.48
223	1.4.4.2.7	Refine plumbing ICDs	Mon 6/29/20	Fri 7/24/20	0.8 wks	4 wks	CavedoniC_C[10%],KangS_C[	220	$2,864.96
224	1.4.4.2.8	Prepare critical mechanical layout, assembly, and fab drawings	Mon 7/27/20	Fri 11/13/20	3.2 wks	16 wks	CavedoniC_C[10%],KangS_C[	221	$11,459.84
225	1.4.4.2.9	Prepare critical mechanical balancing plan and sequence of balancing telescope thru Build Sequence	Mon 7/27/20	Fri 11/13/20	3.2 wks	16 wks	CavedoniC_C[20%]	221	$11,459.84
226	1.4.4.2.10	Prepare critical mechanical mounting assembly and fab drawings	Mon 7/27/20	Fri 11/13/20	8 wks	16 wks	CavedoniC_C[10%],KangS_C[	221	$28,649.60
227	1.4.4.2.11	Prepare critical electrical power fab drawings	Mon 7/27/20	Fri 11/13/20	4.8 wks	16 wks	KarewiczS_C[30%]	222	$17,189.76
228	1.4.4.2.12	Prepare critical plumbing schematic and fab drawings	Mon 7/27/20	Fri 12/11/20	2 wks	20 wks	CavedoniC_C[10%]	221	$7,162.40
229	1.4.4.2.13	Prepare critical MEP cost estimates	Mon 11/16/20	Fri 1/22/21	2 wks	10 wks	CavedoniC_C[10%],KarewiczS	228FS-4 wks	$7,162.40
230	1.4.4.2.14	Prepare critical MEP schedule estimates	Mon 11/16/20	Fri 1/22/21	2 wks	10 wks	CavedoniC_C[10%],KarewiczS	228FS-4 wks	$7,162.40
231	1.4.4.2.15	Prepare CD MEP Documents	Mon 11/30/20	Wed 1/20/21	10.64 wks	7.6 wks	CavedoniC_C[50%],KangS_C[	228FS-2 wks	$38,103.97
232	1.4.4.2.16	Review and address CD MEP Comments, Concerns & Questions	Thu 1/28/21	Thu 1/28/21	0.25 wks	0.1 wks	CavedoniC_C,KangS_C,Karev		$895.30
233	**1.4.4.3**	**Control Computer Software**	**Mon 6/1/20**	**Fri 11/27/20**	**19.8 wks**	**26 wks**		**8**	**$68,661.28**
234	1.4.4.3.1	Design BTO software (produce detailed design doc)	Mon 6/1/20	Fri 7/10/20	6 wks	6 wks	EbbersA_C[50%],RamboldW_		$21,054.00
235	1.4.4.3.2	Design LIS changes (produce detailed design doc)	Mon 7/13/20	Fri 7/24/20	2 wks	2 wks	EbbersA_C[50%],KarewiczS_(	234	$6,844.80
236	1.4.4.3.3	Design interface changes (if needed)	Mon 7/27/20	Fri 8/7/20	1 wk	2 wks	EbbersA_C[50%]	235	$3,263.60
237	1.4.4.3.4	Design fast steering mirror (FSM) control	Mon 8/10/20	Fri 9/4/20	2 wks	4 wks	EbbersA_C[50%]	236	$6,527.20
238	1.4.4.3.5	Design Laser Control Console (produce detailed design doc)	Mon 9/7/20	Fri 10/2/20	4 wks	4 wks	EbbersA_C[50%],RamboldW_	237	$14,036.00
239	1.4.4.3.6	Design interface to new heat exchanger	Mon 10/5/20	Fri 11/27/20	4.8 wks	8 wks	EbbersA_C[10%],KarewiczS_(	238	$16,935.68
240	1.4.5	Build	Mon 1/11/21	Sat 1/21/23	222.12 wks	106 wks			$723,741.07
241	**1.4.5.1**	**Order and receive optical parts and tools necessary to build and align LGSF units. Build BTO units in lab and order BTO enclosure from vendor after soliciting quotes. Integrate, align, and test BTO, Laser Head, and LLT in lab before attaching components.**	**Tue 2/2/21**	**Fri 9/30/22**	**58.99 wks**	**86.8 wks**			**$191,994.72**
242	1.4.5.1.1	Order optical and opto-mechanical components	Tue 2/2/21	Mon 2/15/21	1.5 wks	2 wks	SchneiderT_B[75%]		$5,533.20
243	1.4.5.1.2	Solicit quotes for BTO enclosure builds	Tue 2/2/21	Mon 2/15/21	0.2 wks	2 wks	SchneiderT_B[5%],CavedoniC		$737.76
244	1.4.5.1.3	Receive BTO enclosures	Mon 5/3/21	Sat 5/8/21	0.2 wks	1 wk	SchneiderT_B[10%],Cavedoni		$737.76
245	1.4.5.1.4	Assemble optical components of 3 BTO optical benches and enclosures in lab	Fri 6/4/21	Thu 7/15/21	9 wks	6 wks	SchneiderT_B[50%],Tech3_B		$28,022.40
246	1.4.5.1.5	Build software controls for BTO opto-electronics	Wed 3/10/21	Tue 6/1/21	12 wks	12 wks	EbbersA_B		$40,339.20
247	1.4.5.1.6	Wire BTO opto-electronics	Mon 6/7/21	Sun 8/1/21	4 wks	8 wks	Tech2_B[50%]		$11,304.00
248	1.4.5.1.7	Test full BTO functionality in lab with alignment laser	Fri 6/18/21	Thu 7/1/21	1.28 wks	2 wks	SchneiderT_B[50%],EbbersA_		$4,386.26
249	**1.4.5.1.8**	**Laser System #1**	**Mon 10/4/21**	**Tue 2/1/22**	**14.21 wks**	**17.4 wks**			**$46,066.86**
250	1.4.5.1.8.1	Receive LLT #1 for acceptance test in lab	Mon 10/4/21	Fri 10/15/21	1.21 wks	2 wks	SchneiderT_B[50%],Tech3_B[		$3,616.46
251	1.4.5.1.8.2	Integrate LLT #1 on BTO #1 optical bench for testing	Tue 10/19/21	Mon 11/1/21	2 wks	2 wks	SchneiderT_B[50%],Tech3_B[		$6,514.80
252	1.4.5.1.8.3	Receive Toptica laser #1, conduct acceptance testing in lab	Tue 11/2/21	Mon 11/15/21	2 wks	2 wks	SchneiderT_B[50%],Tech3_B[		$6,514.80



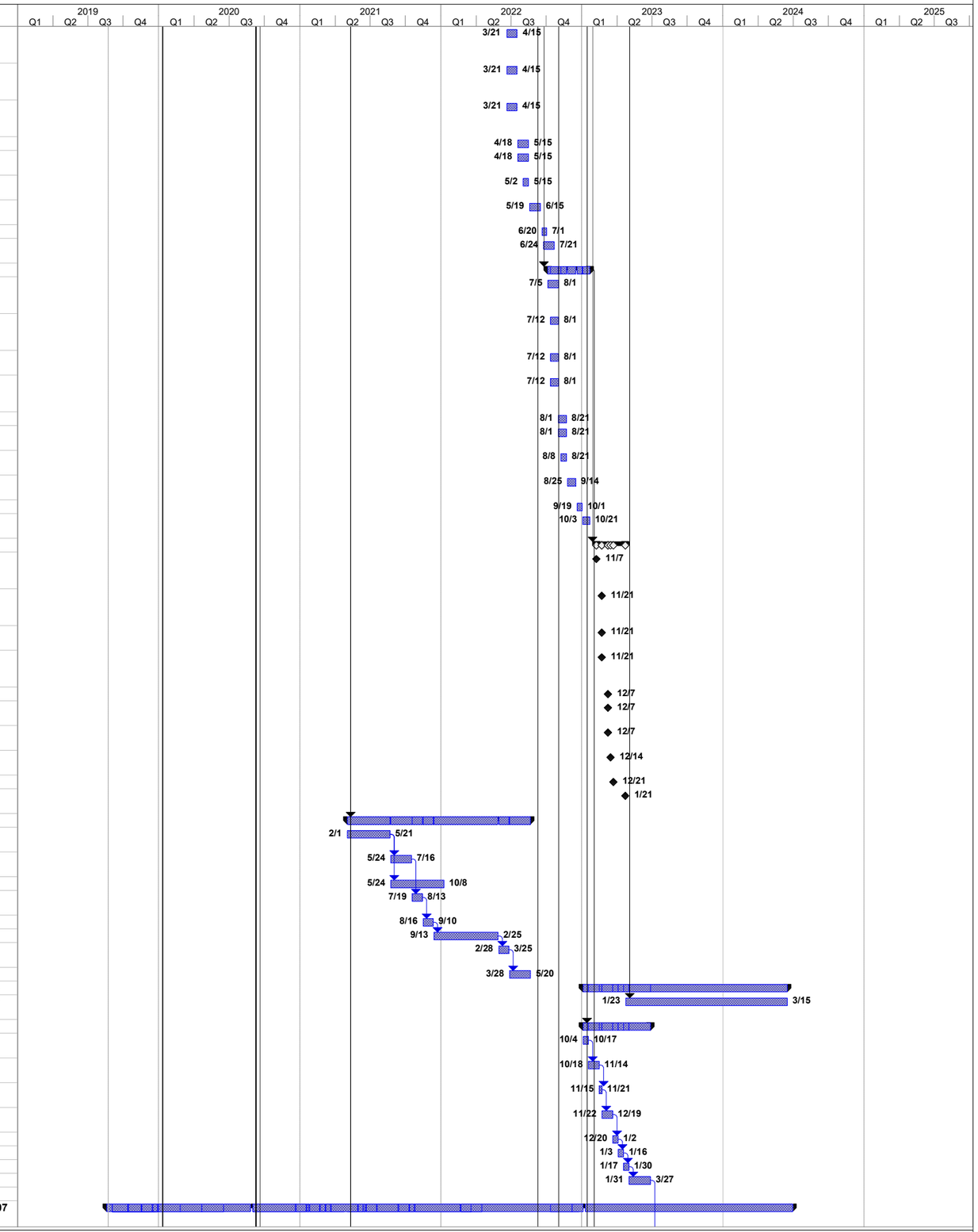
Gemini GNAO/RTC Work Breakdown Structure, 5/21/19

ID	WBS	Task Name	Start	Finish	Work	Duration	Resource Names	Predecessors	Cost
253	1.4.5.1.8.4	Integrate Toptica laser #1, LLT #1, and optical bench for testing and qualification	Thu 11/18/21	Wed 12/1/21	2 wks	2 wks	SchneiderT_B[50%],Tech3_B[		$6,514.80
254	1.4.5.1.8.5	Receive LLT #2 for acceptance test in lab	Mon 12/20/21	Sat 1/1/22	2 wks	2 wks	SchneiderT_B[50%],Tech3_B[		$6,514.80
255	1.4.5.1.8.6	Integrate LLT #2 onto LGSF 1	Mon 1/3/22	Sat 1/15/22	2 wks	2 wks	SchneiderT_B[50%],Tech3_B[		$6,514.80
256	1.4.5.1.8.7	Test full functionality of LGSF 1 in lab	Wed 1/19/22	Tue 2/1/22	3 wks	2 wks	SchneiderT_B,EbbersA_B,Tec		$9,876.40
257	**1.4.5.1.9**	**Laser System #2**	**Wed 2/2/22**	**Sun 5/15/22**	**15 wks**	**14.6 wks**			**$48,965.20**
258	1.4.5.1.9.1	Receive LLT #3 for acceptance test in lab	Wed 2/2/22	Tue 2/15/22	2 wks	2 wks	SchneiderT_B[50%],Tech3_B[		$6,514.80
259	1.4.5.1.9.2	Integrate LLT #3 on BTO #2 for testing	Wed 2/16/22	Tue 3/1/22	2 wks	2 wks	SchneiderT_B[50%],Tech3_B[		$6,514.80
260	1.4.5.1.9.3	Receive LLT #4 for acceptance test in lab	Wed 3/2/22	Tue 3/15/22	2 wks	2 wks	SchneiderT_B[50%],Tech3_B[		$6,514.80
261	1.4.5.1.9.4	Integrate LLT #4 on BTO #2 for testing	Mon 3/21/22	Fri 4/1/22	2 wks	2 wks	SchneiderT_B[50%],Tech3_B[		$6,514.80
262	1.4.5.1.9.5	Receive Toptica laser #2, conduct acceptance testing in lab	Mon 4/4/22	Fri 4/15/22	2 wks	2 wks	SchneiderT_B[50%],Tech3_B[		$6,514.80
263	1.4.5.1.9.6	Integrate Toptica laser #2, LLTs #3+4, and BTO for testing and qualification (LGSF 2)	Mon 4/18/22	Sun 5/1/22	2 wks	2 wks	SchneiderT_B[50%],Tech3_B[		$6,514.80
264	1.4.5.1.9.7	Test full functionality of LGSF 2 in lab	Mon 5/2/22	Sun 5/15/22	3 wks	2 wks	SchneiderT_B,EbbersA_B,Tec		$9,876.40
265	**1.4.5.1.10**	**Laser System #3 (if needed)**	**Wed 6/1/22**	**Thu 9/1/22**	**0 wks**	**13.2 wks**			**$0.00**
266	1.4.5.1.10.1	Receive LLT #5 for acceptance test in lab	Wed 6/1/22	Wed 6/1/22	0 wks	0 wks	SchneiderT_B[50%],Tech3_B[		$0.00
267	1.4.5.1.10.2	Integrate LLT #5 on BTO #3 for testing	Wed 6/15/22	Wed 6/15/22	0 wks	0 wks	SchneiderT_B[50%],Tech3_B[		$0.00
268	1.4.5.1.10.3	Receive LLT #6 for acceptance test in lab	Fri 7/1/22	Fri 7/1/22	0 wks	0 wks	SchneiderT_B[50%],Tech3_B[		$0.00
269	1.4.5.1.10.4	Integrate LLT #6 on BTO #3 for testing	Fri 7/15/22	Fri 7/15/22	0 wks	0 wks	SchneiderT_B[50%],Tech3_B[		$0.00
270	1.4.5.1.10.5	Remove old Toptica laser from telescope for integration into BTO #3	Mon 8/1/22	Mon 8/1/22	0 wks	0 wks	SchneiderT_B,CavedoniC_B,T		$0.00
271	1.4.5.1.10.6	Integrate Toptica laser #3, LLTs #5+6, and BTO #3 for testing and qualification (LGSF 3)	Mon 8/15/22	Mon 8/15/22	0 wks	0 wks	SchneiderT_B[50%],Tech3_B[		$0.00
272	1.4.5.1.10.7	Test full functionality of LGSF 3 in lab	Thu 9/1/22	Thu 9/1/22	0 wks	0 wks	SchneiderT_B,EbbersA_B,Tec		$0.00
273	1.4.5.1.11	BTO optics detailed documentation	Mon 3/22/21	Fri 9/30/22	1.6 wks	80 wks	SchneiderT_B[2%]		$5,902.08
274	**1.4.5.2**	**Receive, Build and Install MEP hardware and systems including all necessary alignment tools, mounting hardware and telescope balancing hardware for LGS**	**Mon 1/11/21**	**Sat 1/21/23**	**119.13 wks**	**106 wks**			**$377,946.35**
275	1.4.5.2.1	Solicit final quotes and release orders for all fabricated hardware including LLT mounts, LH mounts, EC mounts, BTO mounts, LHX mounts, alignment tools and balancing hardware	Mon 2/8/21	Sat 5/1/21	2.4 wks	12 wks	CavedoniC_B[20%]		$8,853.12
276	1.4.5.2.2	Solicit final quotes and release orders for all electrical components including cabling, electrical devices, cable trays and enclosures	Mon 3/8/21	Sat 5/1/21	1.53 wks	8 wks	KarewiczS_B[10%],Tech2_B[1		$5,006.31
277	1.4.5.2.3	Solicit final quotes and release orders for all plumbing components including hoses, control valves, sensors and gauges	Mon 3/8/21	Sat 5/1/21	0.8 wks	8 wks	CavedoniC_B[10%]		$2,951.04
278	1.4.5.2.4	Receive and perform on-site off-telescope LHX acceptance & verification test (must complete prior testing Toptica lasers in Lab)	Mon 4/19/21	Sat 5/1/21	1.2 wks	2 wks	CavedoniC_B[25%],KarewiczS		$4,102.28
279	1.4.5.2.5	Install and test LHX cooling system including end-of-day telescope balancing	Mon 3/8/21	Sat 5/1/21	8 wks	8 wks	CavedoniC_B[20%],KarewiczS		$25,107.20
280	1.4.5.2.6	Complete necessary Job Safety Analysis (JSA) for the installation of hardware on telescope	Mon 1/11/21	Sat 5/1/21	1.6 wks	16 wks	CavedoniC_B[5%],Tech1_B[5		$5,211.84
281	1.4.5.2.7	Receive, assembly and prep off-telescope Electrical hardware including conduit runs, cable trays, enclosures, connectors and patch panels	Mon 2/22/21	Sat 5/1/21	3 wks	10 wks	KarewiczS_B[10%],Tech2_B[3		$9,340.80
282	1.4.5.2.8	Receive, assembly and prep off-telescope Plumbing hardware including hose runs, cable trays, valves , meters & sensors	Mon 2/8/21	Sat 5/1/21	7.2 wks	12 wks	CavedoniC_B[10%],KarewiczS		$22,417.92
283	1.4.5.2.9	Receive, assemble and prep off-telescope Balancing Hardware	Mon 3/8/21	Sat 5/1/21	1.6 wks	8 wks	CavedoniC_B[5%],Tech2_B[1		$4,866.72
284	1.4.5.2.10	Receive, assembly and prep off-telescope Mechanical hardware including EC/LH mounting hardware, BTO mounting hardware, LLT mounting hardware and alignment hardware	Tue 5/18/21	Mon 11/1/21	14.4 wks	24 wks	CavedoniC_B[20%],KangS_B[		$48,977.28
285	1.4.5.2.11	Demo out and/or relocate telescope hardware and services interfering with LGSF installation including (+/-) Y Center Section items	Tue 8/10/21	Mon 11/1/21	7.2 wks	12 wks	CavedoniC_B[10%],KangS_B[		$22,417.92
286	1.4.5.2.12	Install Electrical hardware including conduit runs, cable trays, enclosures & connectors including daily end-of-day telescope balancing	Tue 7/13/21	Mon 11/1/21	8.8 wks	16 wks	CavedoniC_B[5%],KarewiczS_		$26,939.52
287	1.4.5.2.13	Install mechanical balancing hardware including daily end-of-day telescope balancing	Tue 8/24/21	Mon 11/1/21	5 wks	10 wks	CavedoniC_B[10%],Tech1_B[4		$14,992.80
288	1.4.5.2.14	Install telescope pluimbing services including daily end-of-day telescope balacing	Tue 8/10/21	Mon 11/1/21	6 wks	12 wks	CavedoniC_B[10%],Tech1_B[4		$17,991.36
289	1.4.5.2.15	Install mechanical interface hardware for LLTs, BTOs & LHs includng daily end-of-day telescope balancing	Wed 11/10/21	Tue 3/1/22	8.8 wks	16 wks	CavedoniC_B[10%],Tech1_B[4		$26,939.52
290	1.4.5.2.16	Laser System #1	Mon 3/7/22	Thu 7/21/22	23.6 wks	19.8 wks		249	$74,798.08
291	1.4.5.2.16.1	Install Laser System #1 equipment mounts (EC/LH/BTO/LLT) including end-of-day telescope balacing	Mon 3/7/22	Fri 4/15/22	3.6 wks	6 wks	CavedoniC_B[20%],Tech1_B[4		$11,208.96



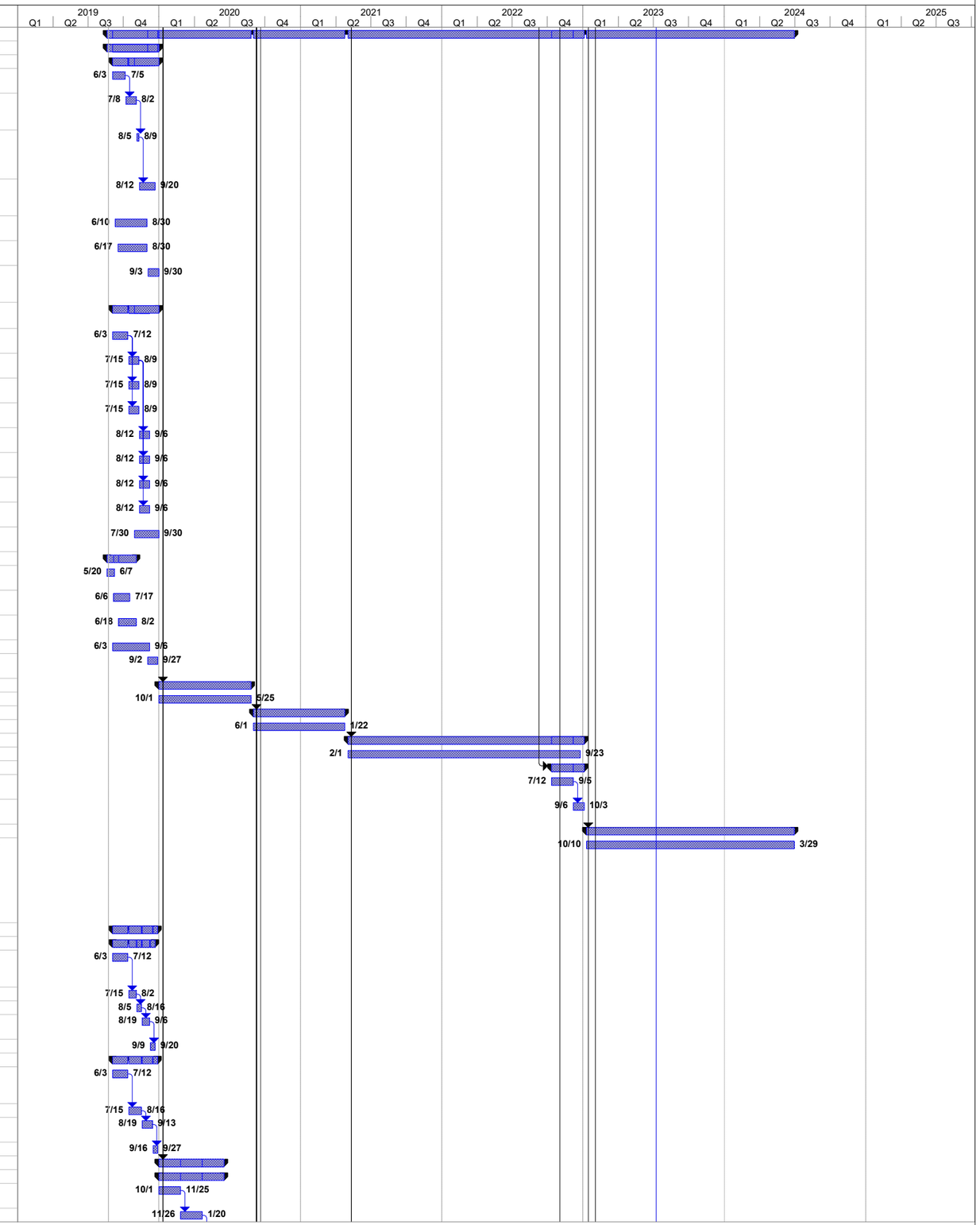
Gemini GNAO/RTC Work Breakdown Structure, 5/21/19

ID	WBS	Task Name	Start	Finish	Work	Duration	Resource Names	Predecessors	Cost
292	1.4.5.2.16.2	Install Laser System #1 Toptica EC & LH includng end-of-day telescope balancing	Mon 3/21/22	Fri 4/15/22	2.4 wks	4 wks	CavedoniC_B[20%],Tech1_B[4		$7,472.64
293	1.4.5.2.16.3	Install Laser System # 1 BTO including end-of-day telescope balancing	Mon 3/21/22	Fri 4/15/22	2.4 wks	4 wks	CavedoniC_B[20%],Tech1_B[4		$7,472.64
294	1.4.5.2.16.4	Install laser System #1 LLTs A&B including end-of-day telescope balancing	Mon 3/21/22	Fri 4/15/22	2.4 wks	4 wks	CavedoniC_B[20%],Tech1_B[4		$7,472.64
295	1.4.5.2.16.5	Mechanically align Laser System #1	Mon 4/18/22	Sun 5/15/22	2.4 wks	4 wks	CavedoniC_B[20%],Tech1_B[4		$7,472.64
296	1.4.5.2.16.6	Install and test power to Laser System #1	Mon 4/18/22	Sun 5/15/22	2.4 wks	4 wks	Tech1_B[20%],Tech2_B[40%]		$6,782.40
297	1.4.5.2.16.7	Install and test cooing to Laser System #1	Mon 5/2/22	Sun 5/15/22	1.2 wks	2 wks	CavedoniC_B[20%],Tech1_B[4		$3,736.32
298	1.4.5.2.16.8	Install and test communicaiton and control to Laser System #1	Thu 5/19/22	Wed 6/15/22	2.4 wks	4 wks	KarewiczS_B[20%],EbbersA_E		$7,901.12
299	1.4.5.2.16.9	Optically align Laser System #1	Mon 6/20/22	Fri 7/1/22	1.2 wks	2 wks	Tech3_B[40%],SchneiderT_B[		$3,736.32
300	4.5.2.16.10	Integrate and commission Laser System #1	Fri 6/24/22	Thu 7/21/22	3.2 wks	4 wks	SchneiderT_B[20%],Cavedoni		$11,542.40
301	1.4.5.2.17	Laser System #2	Tue 7/5/22	Fri 10/21/22	18 wks	15.8 wks		257	$57,032.64
302	1.4.5.2.17.1	Install Laser System #2 equipment mounts (EC/LH/BTO/LLT) including end-of-day telescope balacing	Tue 7/5/22	Mon 8/1/22	2.4 wks	4 wks	CavedoniC_B[20%],Tech1_B[4		$7,472.64
303	1.4.5.2.17.2	Install Laser System #2 Toptica EC & LH includng end-of-day telescope balancing	Tue 7/12/22	Mon 8/1/22	1.8 wks	3 wks	CavedoniC_B[20%],Tech1_B[4		$5,604.48
304	1.4.5.2.17.3	Install Laser System #2 BTO including end-of-day telescope balancing	Tue 7/12/22	Mon 8/1/22	1.8 wks	3 wks	CavedoniC_B[20%],Tech1_B[4		$5,604.48
305	1.4.5.2.17.4	Install laser System #2 LLTs A&B including end-of-day telescope balancing	Tue 7/12/22	Mon 8/1/22	1.8 wks	3 wks	CavedoniC_B[20%],Tech1_B[4		$5,604.48
306	1.4.5.2.17.5	Mechanically align Laser System #2	Mon 8/1/22	Sun 8/21/22	1.8 wks	3 wks	CavedoniC_B[20%],Tech1_B[4		$5,604.48
307	1.4.5.2.17.6	Install and test power to Laser System #2	Mon 8/1/22	Sun 8/21/22	1.8 wks	3 wks	Tech1_B[20%],Tech2_B[40%]		$5,086.80
308	1.4.5.2.17.7	Install and test cooing to Laser System #2	Mon 8/8/22	Sun 8/21/22	1.2 wks	2 wks	CavedoniC_B[20%],Tech1_B[4		$3,736.32
309	1.4.5.2.17.8	Install and test communicaiton and control to Laser System #2	Thu 8/25/22	Wed 9/14/22	1.8 wks	3 wks	KarewiczS_B[20%],EbbersA_E		$5,925.84
310	1.4.5.2.17.9	Optically align Laser System #2	Mon 9/19/22	Sat 10/1/22	1.2 wks	2 wks	Tech3_B[40%],SchneiderT_B[		$3,736.32
311	4.5.2.17.10	Integrate and commission Laser System #2	Mon 10/3/22	Fri 10/21/22	2.4 wks	3 wks	SchneiderT_B[20%],Cavedoni		$8,656.80
312	1.4.5.2.18	Laser System #3 (if needed)	Mon 11/7/22	Sat 1/21/23	0 wks	10.8 wks		265	$0.00
313	1.4.5.2.18.1	Install Laser System #3 equipment mounts (EC/LH/BTO/LLT) including end-of-day telescope balacing	Mon 11/7/22	Mon 11/7/22	0 wks	0 wks	CavedoniC_B[20%],Tech1_B[4		$0.00
314	1.4.5.2.18.2	Install Laser System #3 Toptica EC & LH includng end-of-day telescope balancing	Mon 11/21/22	Mon 11/21/22	0 wks	0 wks	CavedoniC_B[20%],Tech1_B[4		$0.00
315	1.4.5.2.18.3	Install Laser System #3 BTO including end-of-day telescope balancing	Mon 11/21/22	Mon 11/21/22	0 wks	0 wks	CavedoniC_B[20%],Tech1_B[4		$0.00
316	1.4.5.2.18.4	Install laser System #3 LLTs A&B including end-of-day telescope balancing	Mon 11/21/22	Mon 11/21/22	0 wks	0 wks	CavedoniC_B[20%],Tech1_B[4		$0.00
317	1.4.5.2.18.5	Mechanically align Laser System #3	Wed 12/7/22	Wed 12/7/22	0 wks	0 wks	CavedoniC_B[20%],Tech1_B[4		$0.00
318	1.4.5.2.18.6	Install and test power to Laser System #3	Wed 12/7/22	Wed 12/7/22	0 wks	0 wks	Tech1_B[20%],Tech2_B[40%]		$0.00
319	1.4.5.2.18.7	Install and test cooing to Laser System #3	Wed 12/7/22	Wed 12/7/22	0 wks	0 wks	CavedoniC_B[20%],Tech1_B[4		$0.00
320	1.4.5.2.18.8	Install and test communicaiton and control to Laser System #3	Wed 12/14/22	Wed 12/14/22	0 wks	0 wks	KarewiczS_B[20%],EbbersA_E		$0.00
321	1.4.5.2.18.9	Optically align Laser System #3	Wed 12/21/22	Wed 12/21/22	0 wks	0 wks	Tech3_B[40%],SchneiderT_B[		$0.00
322	4.5.2.18.10	Integrate and commission Laser System #3	Sat 1/21/23	Sat 1/21/23	0 wks	0 wks	SchneiderT_B[20%],Cavedoni		$0.00
323	**1.4.5.3**	**Control Computer Software**	**Mon 2/1/21**	**Fri 5/20/22**	**44 wks**	**68 wks**		**11**	**$153,800.00**
324	1.4.5.3.1	Implement LIS design in PLC (includes BTO door switches)	Mon 2/1/21	Fri 5/21/21	8 wks	16 wks	KarewiczS_B[50%]		$29,510.40
325	1.4.5.3.2	Implement LIS design in EPICS (providing UI for PLC implementation)	Mon 5/24/21	Fri 7/16/21	4 wks	8 wks	EbbersA_B[50%]	324	$13,446.40
326	1.4.5.3.3	Implement LHX interface in PLC	Mon 5/24/21	Fri 10/8/21	10 wks	20 wks	KarewiczS_B[50%]	324	$36,888.00
327	1.4.5.3.4	Implement LHX interface in EPICS (providing UI for PLC implementation)	Mon 7/19/21	Fri 8/13/21	2 wks	4 wks	EbbersA_B[50%]	325	$6,723.20
328	1.4.5.3.5	Implement changes to TLEI (if needed)	Mon 8/16/21	Fri 9/10/21	2 wks	4 wks	EbbersA_B[50%]	327	$6,723.20
329	1.4.5.3.6	Implement BTO	Mon 9/13/21	Fri 2/25/22	12 wks	24 wks	EbbersA_B[50%]	328	$40,339.20
330	1.4.5.3.7	Implement fast steering mirror (FSM) control	Mon 2/28/22	Fri 3/25/22	2 wks	4 wks	EbbersA_B[50%]	329	$6,723.20
331	1.4.5.3.8	Implement Laser Control Console	Mon 3/28/22	Fri 5/20/22	4 wks	8 wks	EbbersA_B[50%]	330	$13,446.40
332	1.4.6	Integrate and Test (I&T)	Tue 10/4/22	Fri 3/15/24	47 wks	75.8 wks			$179,927.60
333	1.4.6.1	Provide I&T support and Final Document Preparation	Mon 1/23/23	Fri 3/15/24	30 wks	60 wks	MarinE_I[20%],CavedoniC_I[1	240	$117,396.00
334	**1.4.6.2**	**Control Computer Software**	**Tue 10/4/22**	**Mon 3/27/23**	**17 wks**	**25 wks**		**14**	**$62,531.60**
335	1.4.6.2.1	Test LIS Interface for each Laser (Toptica EC to LIS PLC)	Tue 10/4/22	Mon 10/17/22	1 wk	2 wks	KarewiczS_I[50%]		$3,913.20
336	1.4.6.2.2	Test LIS shuttering sequences with all lasers	Tue 10/18/22	Mon 11/14/22	4 wks	4 wks	EbbersA_I[50%],KarewiczS_I[	335	$14,958.40
337	1.4.6.2.3	Test access door interlocks and bypasses.	Tue 11/15/22	Mon 11/21/22	1 wk	1 wk	EbbersA_I[50%],KarewiczS_I[	336	$3,739.60
338	1.4.6.2.4	Test all BTO functionality (motors, loops, status, error handling)	Tue 11/22/22	Mon 12/19/22	3 wks	4 wks	EbbersA_I[50%],SchneiderT_I	337	$11,045.20
339	1.4.6.2.5	Test any new features	Tue 12/20/22	Mon 1/2/23	1 wk	2 wks	EbbersA_I[50%]	338	$3,566.00
340	1.4.6.2.6	Test LHX	Tue 1/3/23	Mon 1/16/23	2 wks	2 wks	EbbersA_I[50%],KarewiczS_I[	339	$7,479.20
341	1.4.6.2.7	Test fast steering mirror (FSM) control	Tue 1/17/23	Mon 1/30/23	1 wk	2 wks	EbbersA_I[50%]	340	$3,566.00
342	1.4.6.2.8	Test Laser Control Console	Tue 1/31/23	Mon 3/27/23	4 wks	8 wks	EbbersA_I[50%]	341	$14,264.00
343									
344	**1.5**	**Adaptive Optics Subsystem (AOS) (mostly a subcontract)**	**Mon 5/20/19**	**Fri 3/29/24**	**268.49 wks**	**254 wks**			**$1,001,914.07**



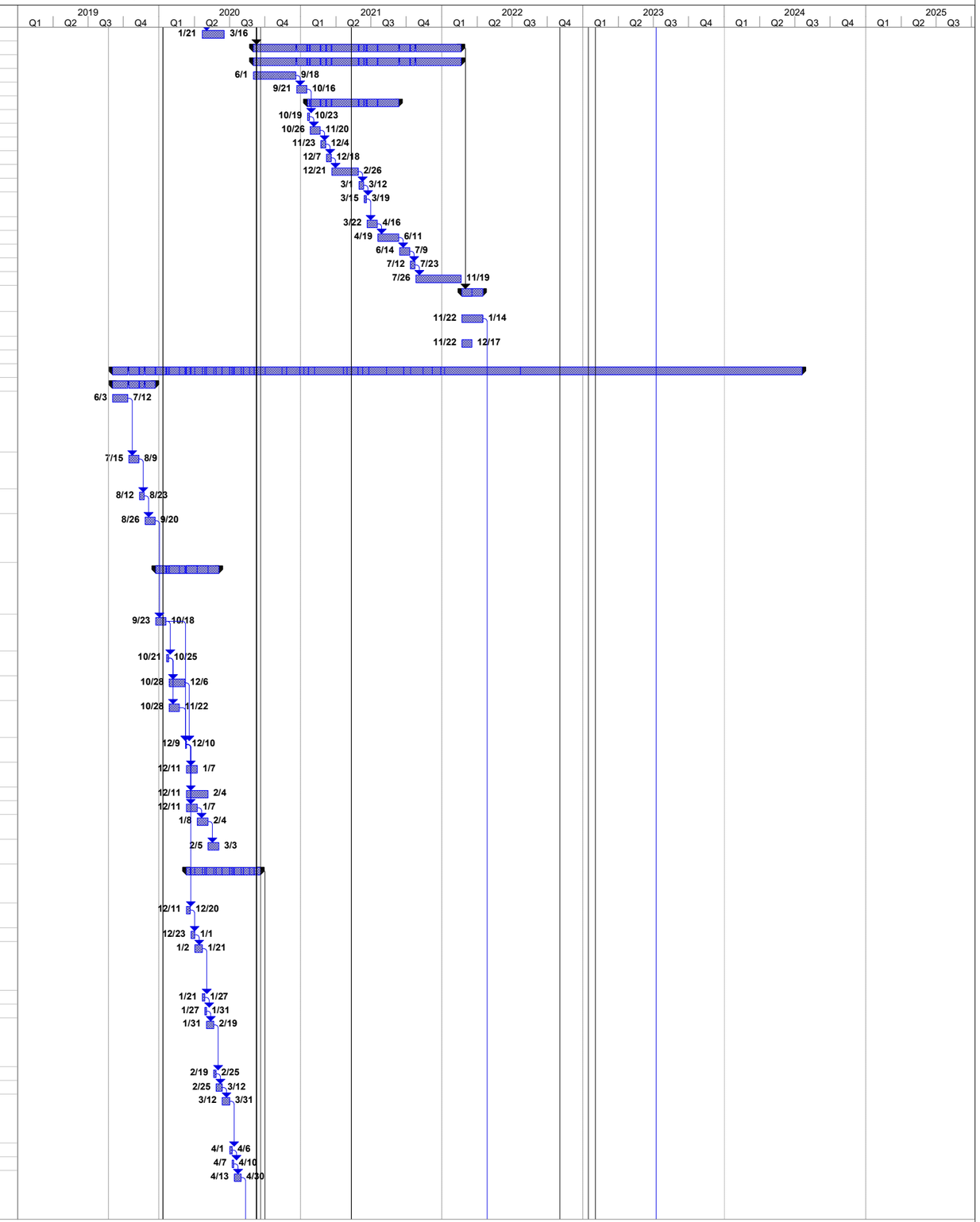
Gemini GNAO/RTC Work Breakdown Structure, 5/21/19

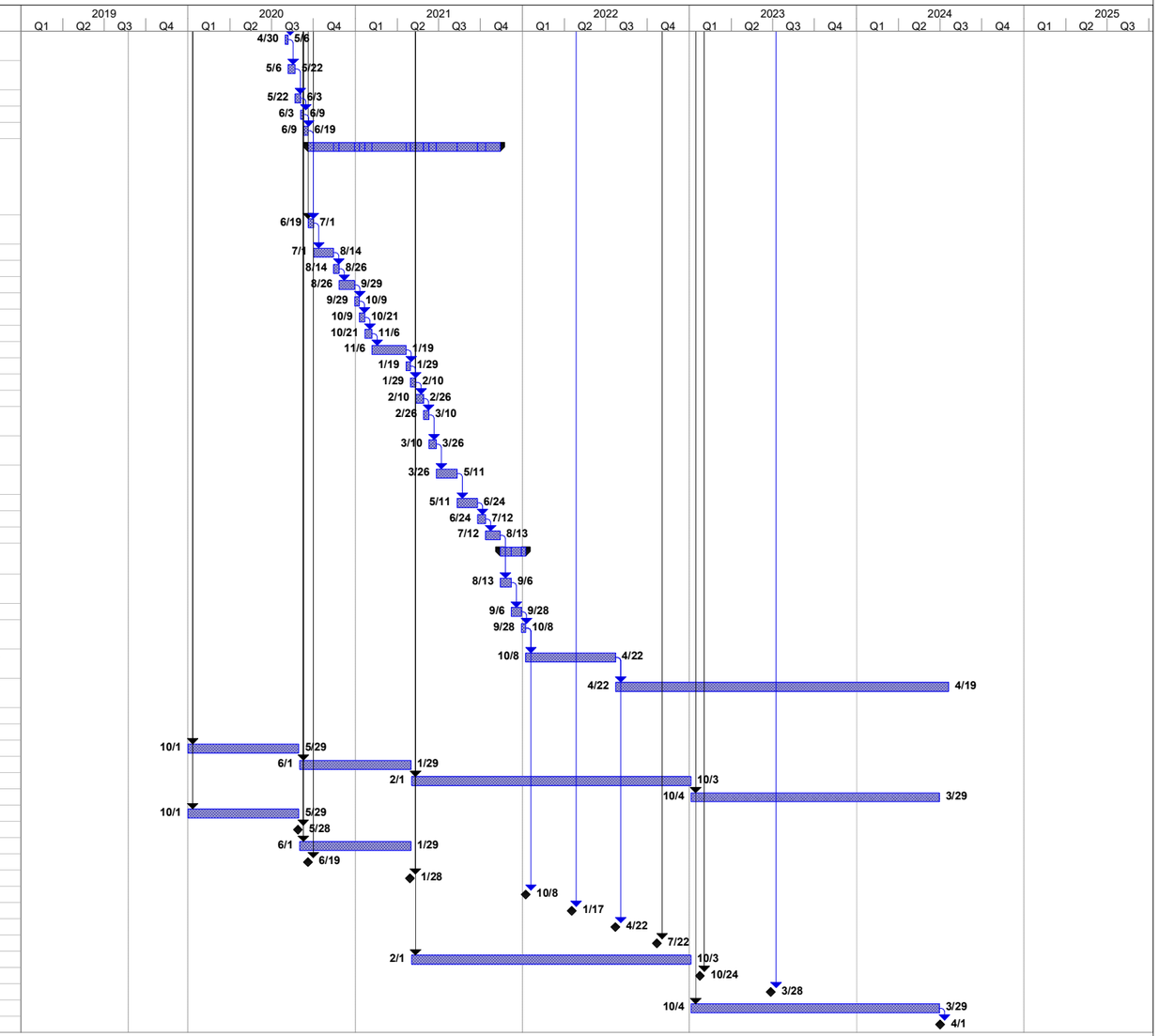
ID	WBS	Task Name	Start	Finish	Work	Duration	Resource Names	Predecessors	Cost
345	**1.5.1**	**AOS System Engineering**	**Mon 5/20/19**	**Fri 3/29/24**	**138.99 wks**	**254 wks**			**$517,280.47**
346	**1.5.1.1**	**Conceptual Design**	**Mon 5/20/19**	**Mon 9/30/19**	**45.64 wks**	**19.2 wks**			**$158,751.15**
347	**1.5.1.1.1**	**AOS Subsystem Requirements Definition**	**Mon 6/3/19**	**Mon 9/30/19**	**28.97 wks**	**17.2 wks**			**$101,266.21**
348	1.5.1.1.1.1	Generate AOS Top Level Functional Flow Break Down	Mon 6/3/19	Fri 7/5/19	2 wks	5 wks	ProvostN_P[5%],MontesV_P[2		$6,855.50
349	1.5.1.1.1.2	Flow Top Level Requirements to AOS from top level science Requirements (Second Draft)	Mon 7/8/19	Fri 8/2/19	1.8 wks	4 wks	ProvostN_P[5%],RamboldW_F	348	$6,359.28
350	1.5.1.1.1.3	Generate AOS Functional Requirements and compare against existing GN and GS LGS requirements (Second Draft)	Mon 8/5/19	Fri 8/9/19	0.45 wks	1 wk	ProvostN_P[5%],RamboldW_F	349	$1,589.82
351	1.5.1.1.1.4	Update Requirements based on Interface Definition, Conops, Trade Study Results etc, Add rationale	Mon 8/12/19	Fri 9/20/19	1.2 wks	6 wks	ProvostN_P[5%],MontesV_P[1	350	$4,222.68
352	1.5.1.1.1.5	Generate AOS Verification Plan for each Requirement and fill out VCRM	Mon 6/10/19	Fri 8/30/19	4.2 wks	12 wks	ProvostN_P[5%],RamboldW_F		$14,905.68
353	1.5.1.1.1.6	Input AOS Requirements and Verification Methods into DOORS	Mon 6/17/19	Fri 8/30/19	1.1 wks	11 wks	ProvostN_P[5%],BassettJ_P[5		$4,009.72
354	1.5.1.1.1.7	Finalize Export AOS Subsystem Requirements Document with VCRM for CoDR	Tue 9/3/19	Mon 9/30/19	0.8 wks	4 wks	ProvostN_P[5%],BassettJ_P[5		$2,916.16
355	**1.5.1.1.1.8**	**Generate AOS Interface Requirements Definition**	**Mon 6/3/19**	**Mon 9/30/19**	**17.42 wks**	**17.2 wks**			**$60,407.37**
356	.5.1.1.1.8.1	Define AOS Functional External Interfaces	Mon 6/3/19	Fri 7/12/19	3.32 wks	6 wks	ProvostN_P[10%],MontesV_P[		$11,459.17
357	.5.1.1.1.8.2	Generate AOS Interface Control Document for AOS - RTC First Draft	Mon 7/15/19	Fri 8/9/19	2 wks	4 wks	ProvostN_P[5%],MontesV_P[5	356	$6,875.28
358	.5.1.1.1.8.3	Generate LGS Interface Control Document for AOS - TLC First Draft	Mon 7/15/19	Fri 8/9/19	2 wks	4 wks	ProvostN_P[5%],MontesV_P[5	356	$6,875.28
359	.5.1.1.1.8.4	Generate LGS Interface Control Document for AOS -TCC First Draft	Mon 7/15/19	Fri 8/9/19	2 wks	4 wks	ProvostN_P[5%],MontesV_P[5	356	$6,875.28
360	.5.1.1.1.8.5	Update, Review Electrical Interface Requirements	Mon 8/12/19	Fri 9/6/19	0.6 wks	4 wks	ProvostN_P[5%],MontesV_P[1	357	$2,119.76
361	.5.1.1.1.8.6	Update, Review Mechancial Interface Requirements	Mon 8/12/19	Fri 9/6/19	1 wk	4 wks	ProvostN_P[5%],MontesV_P[5	357	$3,510.48
362	.5.1.1.1.8.7	Update, Review Service Requirements	Mon 8/12/19	Fri 9/6/19	1 wk	4 wks	ProvostN_P[5%],MontesV_P[5	357	$3,510.48
363	.5.1.1.1.8.8	Update, Review Environmental Requirements	Mon 8/12/19	Fri 9/6/19	1 wk	4 wks	ProvostN_P[5%],MontesV_P[5	357	$3,510.48
364	.5.1.1.1.8.9	Review, Update, Finalize CoDR Drafts of ICDs	Tue 7/30/19	Mon 9/30/19	4.5 wks	9 wks	ProvostN_P[10%],MontesV_P[		$15,671.16
365	**1.5.1.1.2**	**Generate AOS Concept of Operations**	**Mon 5/20/19**	**Fri 8/2/19**	**6.28 wks**	**11 wks**			**$21,527.82**
366	1.5.1.1.2.1	Describe GeMS System and Reason for Change	Mon 5/20/19	Fri 6/7/19	1.18 wks	3 wks	ProvostN_P[10%],MontesV_P[		$4,022.00
367	1.5.1.1.2.2	Describe GNAO AOS System Operation (1st Draft)	Thu 6/6/19	Wed 7/17/19	2.1 wks	6 wks	ProvostN_P[10%],MontesV_P[		$7,149.96
368	1.5.1.1.2.3	Review, Update AOS Conops, incorporate into GNAO conops	Tue 6/18/19	Fri 8/2/19	3 wks	6.67 wks	ProvostN_P[10%],MontesV_P[		$10,355.87
369	**1.5.1.1.3**	**Lead and participate in design trades**	**Mon 6/3/19**	**Fri 9/6/19**	**5.6 wks**	**14 wks**	**ProvostN_P[10%],MontesV_I**		**$19,313.28**
370	1.5.1.1.4	Generate, review, and provide input on AOS Package	Mon 9/2/19	Fri 9/27/19	4.8 wks	4 wks	ProvostN_P[10%],MontesV_P[		$16,643.84
371	**1.5.1.2**	**Preliminary (subcontract)**	**Tue 10/1/19**	**Mon 5/25/20**	**6.8 wks**	**34 wks**		**5**	**$24,787.36**
372	1.5.1.2.1	provide SE oversight	Tue 10/1/19	Mon 5/25/20	6.8 wks	34 wks	ProvostN_P[20%]		$24,787.36
373	**1.5.1.3**	**Critical Design (subcontract)**	**Mon 6/1/20**	**Fri 1/22/21**	**6.8 wks**	**34 wks**		**8**	**$25,529.92**
374	1.5.1.3.1	provide SE oversight	Mon 6/1/20	Fri 1/22/21	6.8 wks	34 wks	ProvostN_C[20%]		$25,529.92
375	**1.5.1.4**	**Build (subcontract)**	**Mon 2/1/21**	**Mon 10/3/22**	**22 wks**	**87.2 wks**		**11**	**$84,650.24**
376	1.5.1.4.1	provide SE oversight	Mon 2/1/21	Fri 9/23/22	17.2 wks	86 wks	ProvostN_B[20%]		$66,515.84
377	**1.5.1.4.2**	**AOS Verification**	**Tue 7/12/22**	**Mon 10/3/22**	**4.8 wks**	**12 wks**		**14FS-12 wks**	**$18,134.40**
378	1.5.1.4.2.1	Review Vendor's AOS Acceptance Test Plan	Tue 7/12/22	Mon 9/5/22	3.2 wks	8 wks	ProvostN_B[20%],MontesV_B[		$12,089.60
379	1.5.1.4.2.2	Review and Approve Acceptance Test results	Tue 9/6/22	Mon 10/3/22	1.6 wks	4 wks	ProvostN_B[20%],MontesV_B[	378	$6,044.80
380	**1.5.1.5**	**Integration and Testing (I&T)**	**Mon 10/10/22**	**Fri 3/29/24**	**57.75 wks**	**77 wks**		**14**	**$223,561.80**
381	1.5.1.5.1	Lead AOS Integration and Test in conjunction with the AOS subcontractor, including development of integration test plan, implementing plan, lead anomaly resolution, lead interface management, Perform tests, review and document results	Mon 10/10/22	Fri 3/29/24	57.75 wks	77 wks	ProvostN_I[25%],MontesV_I[2		$223,561.80
382	1.5.2	Conceptual Design	Mon 6/3/19	Fri 9/27/19	16.5 wks	17 wks			$57,367.20
383	**1.5.2.1**	**Optical Engineering**	**Mon 6/3/19**	**Fri 9/20/19**	**8 wks**	**16 wks**			**$27,814.40**
384	1.5.2.1.1	refine conceptual optical design including layout of the AOB, optical elements, and coatings	Mon 6/3/19	Fri 7/12/19	3 wks	6 wks	ChirreE_P[50%]		$10,430.40
385	1.5.2.1.2	perform preliminary tolerancing analysis	Mon 7/15/19	Fri 8/2/19	1.5 wks	3 wks	ChirreE_P[50%]	384	$5,215.20
386	1.5.2.1.3	perform preliminary throughput analysis	Mon 8/5/19	Fri 8/16/19	1 wk	2 wks	ChirreE_P[50%]	385	$3,476.80
387	1.5.2.1.4	assess risks in the conceptual optical design	Mon 8/19/19	Fri 9/6/19	1.5 wks	3 wks	ChirreE_P[50%]	386	$5,215.20
388	1.5.2.1.5	documentation preparation	Mon 9/9/19	Fri 9/20/19	1 wk	2 wks	ChirreE_P[50%]	387	$3,476.80
389	**1.5.2.2**	**Mechanical Engineering**	**Mon 6/3/19**	**Fri 9/27/19**	**8.5 wks**	**17 wks**			**$29,552.80**
390	1.5.2.2.1	refine conceptual mechanical design including structural, science path, LGSWFS, and NGSWFS	Mon 6/3/19	Fri 7/12/19	3 wks	6 wks	ChinnB_P[50%]		$10,430.40
391	1.5.2.2.2	preliminary thermal and flexure studies	Mon 7/15/19	Fri 8/16/19	2.5 wks	5 wks	ChinnB_P[50%]	390	$8,692.00
392	1.5.2.2.3	preliminary optomechanical tolerancing analysis	Mon 8/19/19	Fri 9/13/19	2 wks	4 wks	ChinnB_P[50%]	391	$6,953.60
393	1.5.2.2.4	documentation preparation	Mon 9/16/19	Fri 9/27/19	1 wk	2 wks	ChinnB_P[50%]	392	$3,476.80
394	**1.5.3**	**Preliminary Design**	**Tue 10/1/19**	**Mon 3/16/20**	**24 wks**	**24 wks**		**5**	**$87,484.80**
395	**1.5.3.1**	**Control Computer Software**	**Tue 10/1/19**	**Mon 3/16/20**	**24 wks**	**24 wks**			**$87,484.80**
396	1.5.3.1.1	Adaptive Optics Subsystem Components Controller Design	Tue 10/1/19	Mon 11/25/19	8 wks	8 wks	SE1_P		$29,161.60
397	1.5.3.1.2	Instrument Sequencer Design	Tue 11/26/19	Mon 1/20/20	8 wks	8 wks	SE1_P	396	$29,161.60



Gemini GNAO/RTC Work Breakdown Structure, 5/21/19

ID	WBS	Task Name	Start	Finish	Work	Duration	Resource Names	Predecessors	Cost
398	1.5.3.1.3	Graphical User Interface Design	Tue 1/21/20	Mon 3/16/20	8 wks	8 wks	SE1_P	397	$29,161.60
399	**1.5.4**	**Critical Design**	**Mon 6/1/20**	**Fri 11/19/21**	**77 wks**	**77 wks**		**8**	**$293,375.20**
400	**1.5.4.1**	**Control Computer Software**	**Mon 6/1/20**	**Fri 11/19/21**	**77 wks**	**77 wks**			**$293,375.20**
401	1.5.4.1.1	Implement AOS Components Controller	Mon 6/1/20	Fri 9/18/20	16 wks	16 wks	SE1_C		$60,070.40
402	1.5.4.1.2	Implement Instrument Sequencer	Mon 9/21/20	Fri 10/16/20	4 wks	4 wks	SE1_C	401	$15,017.60
403	**1.5.4.1.3**	**Implement Graphical User Interface**	**Mon 10/19/20**	**Fri 6/11/21**	**34 wks**	**34 wks**			**$129,341.60**
404	1.5.4.1.3.1	Infrastructure	Mon 10/19/20	Fri 10/23/20	1 wk	1 wk	SE1_C	402	$3,754.40
405	1.5.4.1.3.2	AOS Components Controller	Mon 10/26/20	Fri 11/20/20	4 wks	4 wks	SE1_C	404	$15,017.60
406	1.5.4.1.3.3	LGSF Components Controller	Mon 11/23/20	Fri 12/4/20	2 wks	2 wks	SE1_C	405	$7,508.80
407	1.5.4.1.3.4	Loop Control	Mon 12/7/20	Fri 12/18/20	2 wks	2 wks	SE1_C	406	$7,508.80
408	1.5.4.1.3.5	Telemetry Display	Mon 12/21/20	Fri 2/26/21	10 wks	10 wks	SE1_C	407	$37,544.00
409	1.5.4.1.3.6	NGS Configuration	Mon 3/1/21	Fri 3/12/21	2 wks	2 wks	SE1_B	408	$7,734.40
410	1.5.4.1.3.7	Instrument Sequencer display and control	Mon 3/15/21	Fri 3/19/21	1 wk	1 wk	SE1_B	409	$3,867.20
411	1.5.4.1.3.8	Calibration	Mon 3/22/21	Fri 4/16/21	4 wks	4 wks	SE1_B	410	$15,468.80
412	1.5.4.1.3.9	Misc. screens	Mon 4/19/21	Fri 6/11/21	8 wks	8 wks	SE1_B	411	$30,937.60
413	1.5.4.1.4	Implement GIAPI interfaces	Mon 6/14/21	Fri 7/9/21	4 wks	4 wks	SE1_B	412	$15,468.80
414	1.5.4.1.5	Implement Safety Interlocks	Mon 7/12/21	Fri 7/23/21	2 wks	2 wks	SE1_B	413	$7,734.40
415	1.5.4.1.6	Telemetry storage and access control	Mon 7/26/21	Fri 11/19/21	17 wks	17 wks	SE1_B	414	$65,742.40
416	**1.5.5**	**Build / Implement / Incrementally Integrate & Test**	**Mon 11/22/21**	**Fri 1/14/22**	**12 wks**	**8 wks**		**399**	**$46,406.40**
417	1.5.5.1	Control Computer Software Testing of Mechanical Components	Mon 11/22/21	Fri 1/14/22	8 wks	8 wks	SE1_B		$30,937.60
418	1.5.5.2	Finalize And Perform Acceptance Tests	Mon 11/22/21	Fri 12/17/21	4 wks	4 wks	SE1_B		$15,468.80
419									
420	**1.6**	**Real-Time Computer (RTC)**	**Mon 6/3/19**	**Fri 4/19/24**	**270.7 wks**	**254.87 wks**			**$875,260.09**
421	**1.6.1**	**RTC Systems Engineering**	**Mon 6/3/19**	**Fri 9/20/19**	**11.9 wks**	**16 wks**			**$40,394.92**
422	1.6.1.1	flow-down GNAO / GeMS system requirements to the RTC and generate RTC Functional Requirements and compare against existing GN and GS LGS requirements.	Mon 6/3/19	Fri 7/12/19	3 wks	6 wks	HirstP_P[10%],PalmerD_P[10		$12,281.52
423	1.6.1.2	write a draft of the final test document to assure that the requirements can be tested against.	Mon 7/15/19	Fri 8/9/19	2 wks	4 wks	JenkinsD_P[50%]	422	$4,374.40
424	1.6.1.3	design external RTC interfaces and generate ICDs.	Mon 8/12/19	Fri 8/23/19	2.5 wks	2 wks	RamboldW_P[25%],HirstP_P[	423	$8,642.04
425	1.6.1.4	start a Design Document and Users Manual to serve as input to the CoDR documentation package (and to be kept up to date as the project progresses).	Mon 8/26/19	Fri 9/20/19	4.4 wks	4 wks	RamboldW_P[10%],HirstP_P[	424	$15,096.96
426	**1.6.2**	**Select computer hardware (for GeMS) and a software package; then procure it and bring it up (this is to serve as development/test platform)**	**Mon 9/23/19**	**Tue 3/3/20**	**21.6 wks**	**23.4 wks**			**$71,581.60**
427	1.6.2.1	select an existing AO RTC software package to serve as the baseline for RTC software development	Mon 9/23/19	Fri 10/18/19	4 wks	4 wks	HirstP_P[20%],PalmerD_P[20	425	$15,096.88
428	1.6.2.2	participate in AO RTC package training (this is a training place holder)	Mon 10/21/19	Fri 10/25/19	3 wks	1 wk	PalmerD_P,RamboldW_P,Jen	427	$10,823.60
429	1.6.2.3	analyze the requirements for and select AO peripheral interfaces for GeMS	Mon 10/28/19	Fri 12/6/19	6.6 wks	6 wks	HirstP_P[10%],PalmerD_P[10	428	$21,299.52
430	1.6.2.4	analyze the requirements for and select/configure a computer platform for GeMS, including OS	Mon 10/28/19	Fri 11/22/19	0.8 wks	4 wks	HirstP_P[5%],PalmerD_P[5%]	428	$3,454.56
431	1.6.2.5	hold a special review of the software package and hardware selections.	Mon 12/9/19	Tue 12/10/19	1.6 wks	0.4 wks	HirstP_P,PalmerD_P,Rambolc	427,429,430	$6,325.92
432	1.6.2.6	procure software package, including support as required	Wed 12/11/19	Tue 1/7/20	0.4 wks	4 wks	RamboldW_P[10%]	431	$1,458.08
433	1.6.2.7	procure the AO peripheral interfaces for GeMS	Wed 12/11/19	Tue 2/4/20	0.8 wks	8 wks	RamboldW_P[10%]	431	$2,916.16
434	1.6.2.8	procure the computer platform for GeMS	Wed 12/11/19	Tue 1/7/20	0.4 wks	4 wks	RamboldW_P[10%]	431	$1,458.08
435	1.6.2.9	bring up the GeMS hardware platform and optimize for performance	Wed 1/8/20	Tue 2/4/20	2 wks	4 wks	JenkinsD_P[50%]	434	$4,374.40
436	1.6.2.10	install drivers for GeMS AO peripherals and test, as hardware becomes available	Wed 2/5/20	Tue 3/3/20	2 wks	4 wks	JenkinsD_P[50%]	435	$4,374.40
437	**1.6.3**	**Design the adaptation of the AO RTC package to GeMS and design new code as needed. This is the design phase for RTC software.**	**Wed 12/11/19**	**Fri 6/19/20**	**41.2 wks**	**27.47 wks**			**$129,389.97**
438	1.6.3.1	adapt AO RTC package infrastructure to GeMS/GNAO needs	Wed 12/11/19	Fri 12/20/19	2.4 wks	1.6 wks	JenkinsD_P[75%],PalmerD_P[	431	$7,537.28
439	1.6.3.2	TLC interface software	Mon 12/23/19	Wed 1/1/20	2.4 wks	1.6 wks	JenkinsD_P[75%],PalmerD_P[	438	$7,537.28
440	1.6.3.3	NGS camera interface software (the 'Design' work for this is higher than normal, wrt 'Implementation', to accommodate GeMS legacy hardware)	Thu 1/2/20	Tue 1/21/20	4 wks	2.67 wks	JenkinsD_P[75%],PalmerD_P[	439	$12,562.13
441	1.6.3.4	NGS tip/tilt computation	Tue 1/21/20	Mon 1/27/20	1.2 wks	0.8 wks	JenkinsD_P[75%],PalmerD_P[	440	$3,768.64
442	1.6.3.5	TT interface software	Mon 1/27/20	Fri 1/31/20	1.2 wks	0.8 wks	JenkinsD_P[75%],PalmerD_P[	441	$3,768.64
443	1.6.3.6	LGS cameras interface software (the 'Design' work for this is higher than normal, wrt 'Implementation', to accommodate GeMS legacy hardware)	Fri 1/31/20	Wed 2/19/20	4 wks	2.67 wks	JenkinsD_P[75%],PalmerD_P[	442	$12,562.13
444	1.6.3.7	centroider	Wed 2/19/20	Tue 2/25/20	1.2 wks	0.8 wks	JenkinsD_P[75%],PalmerD_P[	443	$3,768.64
445	1.6.3.8	reconstructor	Tue 2/25/20	Thu 3/12/20	3.6 wks	2.4 wks	JenkinsD_P[75%],PalmerD_P[	444	$11,305.92
446	1.6.3.9	DMs interface software (the 'Design' work for this is higher than normal, wrt 'Implementation', to accommodate GeMS legacy hardware)	Thu 3/12/20	Tue 3/31/20	4 wks	2.67 wks	JenkinsD_P[75%],PalmerD_P[	445	$12,562.13
447	1.6.3.10	slow focus detector software	Wed 4/1/20	Mon 4/6/20	1.2 wks	0.8 wks	JenkinsD_P[75%],PalmerD_P[	446	$3,768.64
448	1.6.3.11	slow focus computation	Tue 4/7/20	Fri 4/10/20	1.2 wks	0.8 wks	JenkinsD_P[75%],PalmerD_P[	447	$3,768.64
449	1.6.3.12	LGS zoom interface software (for slow focus) (the 'Design' work for this is higher than normal, wrt 'Implementation', to accommodate GeMS legacy hardware)	Mon 4/13/20	Thu 4/30/20	4 wks	2.67 wks	JenkinsD_P[75%],PalmerD_P[	448	$12,562.13



Gemini GNAO/RTC Work Breakdown Structure, 5/21/19

ID	WBS	Task Name	Start	Finish	Work	Duration	Resource Names	Predecessors	Cost
450	1.6.3.13	telescope offload and LGS pointing control software	Thu 4/30/20	Wed 5/6/20	1.2 wks	0.8 wks	JenkinsD_P[75%],PalmerD_P[	449	$3,768.64
451	1.6.3.14	telemetry date streaming/archiving software	Wed 5/6/20	Fri 5/22/20	3.6 wks	2.4 wks	JenkinsD_P[75%],PalmerD_P[	450	$11,305.92
452	1.6.3.15	telemetry data display software	Fri 5/22/20	Wed 6/3/20	2.4 wks	1.6 wks	JenkinsD_P[75%],PalmerD_P[	451	$7,537.28
453	1.6.3.16	investigate PSF reconstruction	Wed 6/3/20	Tue 6/9/20	1.2 wks	0.8 wks	JenkinsD_P[75%],PalmerD_P[	452	$3,768.64
454	1.6.3.17	reconstructor matrix generation	Tue 6/9/20	Fri 6/19/20	2.4 wks	1.6 wks	JenkinsD_P[75%],PalmerD_P[	453	$7,537.28
455	**1.6.4**	**Implement and test code to provide GeMS functionality as designed in the previous set of tasks. This is the implementation and testing phase for the RTC software (not to be confused with Integration and Test).**	**Fri 6/19/20**	**Fri 8/13/21**	**90 wks**	**60 wks**			**$295,199.60**
456	1.6.4.1	adapt DARC infrastructure to GeMS/GNAO needs	Fri 6/19/20	Wed 7/1/20	2.4 wks	1.6 wks	JenkinsD_C[75%],PalmerD_C	8,454	$7,763.20
457	1.6.4.2	TLC interface software	Wed 7/1/20	Fri 8/14/20	9.6 wks	6.4 wks	JenkinsD_C[75%],PalmerD_C	456	$31,052.80
458	1.6.4.3	NGS camera interface software	Fri 8/14/20	Wed 8/26/20	2.4 wks	1.6 wks	JenkinsD_C[75%],PalmerD_C	457	$7,763.20
459	1.6.4.4	NGS tip/tilt computation	Wed 8/26/20	Tue 9/29/20	7.2 wks	4.8 wks	JenkinsD_C[75%],PalmerD_C	458	$23,289.60
460	1.6.4.5	TT interface software	Tue 9/29/20	Fri 10/9/20	2.4 wks	1.6 wks	JenkinsD_C[75%],PalmerD_C	459	$7,763.20
461	1.6.4.6	LGS cameras interface software	Fri 10/9/20	Wed 10/21/20	2.4 wks	1.6 wks	JenkinsD_C[75%],PalmerD_C	460	$7,763.20
462	1.6.4.7	centroider	Wed 10/21/20	Fri 11/6/20	3.6 wks	2.4 wks	JenkinsD_C[75%],PalmerD_C	461	$11,644.80
463	1.6.4.8	reconstructor	Fri 11/6/20	Tue 1/19/21	15.6 wks	10.4 wks	JenkinsD_C[75%],PalmerD_C	462	$50,460.80
464	1.6.4.9	DMs interface software	Tue 1/19/21	Fri 1/29/21	2.4 wks	1.6 wks	JenkinsD_C[75%],PalmerD_C	463	$7,763.20
465	1.6.4.10	slow focus detector software	Fri 1/29/21	Wed 2/10/21	2.4 wks	1.6 wks	JenkinsD_B[75%],PalmerD_B[	464	$7,996.32
466	1.6.4.11	slow focus computation	Wed 2/10/21	Fri 2/26/21	3.6 wks	2.4 wks	JenkinsD_B[75%],PalmerD_B[	465	$11,994.48
467	1.6.4.12	LGS zoom interface software (for slow focus)	Fri 2/26/21	Wed 3/10/21	2.4 wks	1.6 wks	JenkinsD_B[75%],PalmerD_B[	466	$7,996.32
468	1.6.4.13	telescope offload and LGS pointing control software	Wed 3/10/21	Fri 3/26/21	3.6 wks	2.4 wks	JenkinsD_B[75%],PalmerD_B[	467	$11,994.48
469	1.6.4.14	telemetry date streaming/archiving software	Fri 3/26/21	Tue 5/11/21	9.6 wks	6.4 wks	JenkinsD_B[75%],PalmerD_B[	468	$31,985.28
470	1.6.4.15	telemetry data display software	Tue 5/11/21	Thu 6/24/21	9.6 wks	6.4 wks	JenkinsD_B[75%],PalmerD_B[	469	$31,985.28
471	1.6.4.16	investigate PSF reconstruction	Thu 6/24/21	Mon 7/12/21	3.6 wks	2.4 wks	JenkinsD_B[75%],PalmerD_B[	470	$11,994.48
472	1.6.4.17	reconstructor matrix generation	Mon 7/12/21	Fri 8/13/21	7.2 wks	4.8 wks	JenkinsD_B[75%],PalmerD_B[	471	$23,988.96
473	**1.6.5**	**Perform final testing, integration, and first-light for new GeMS RTC**	**Fri 8/13/21**	**Fri 10/8/21**	**12 wks**	**8 wks**			**$39,981.60**
474	1.6.5.1	finalize the final test document and execute it	Fri 8/13/21	Mon 9/6/21	4.8 wks	3.2 wks	JenkinsD_B[75%],PalmerD_B[	472	$15,992.64
475	1.6.5.2	finalize all documentation and release	Mon 9/6/21	Tue 9/28/21	4.8 wks	3.2 wks	JenkinsD_B[75%],PalmerD_B[	474	$15,992.64
476	1.6.5.3	support GeMS integration and first-light (with the new RTC)	Tue 9/28/21	Fri 10/8/21	2.4 wks	1.6 wks	JenkinsD_B[75%],PalmerD_B[	475	$7,996.32
477	1.6.6	Procure the hardware for GNAO and port the RTC, as developed above, to GNAO.	Fri 10/8/21	Fri 4/22/22	42 wks	28 wks	JenkinsD_B[75%],PalmerD_B[	476	$139,935.60
478	1.6.7	Provide ongoing support through build and integration	Fri 4/22/22	Fri 4/19/24	52 wks	104 wks	JenkinsD_I[25%],RamboldW_	477	$158,776.80
479									
480									
481	1.7	Overall project Preliminary Design	Tue 10/1/19	Fri 5/29/20	0 wks	34.8 wks		5	$0.00
482	1.8	Overall project Critical Design	Mon 6/1/20	Fri 1/29/21	0 wks	35 wks		8	$0.00
483	1.9	Overall project Build	Mon 2/1/21	Mon 10/3/22	0 wks	87.2 wks		11	$0.00
484	1.10	Overall project I&T	Tue 10/4/22	Fri 3/29/24	0 wks	77.8 wks		14	$0.00
485	1.11	AOS Preliminary Design	Tue 10/1/19	Fri 5/29/20	0 wks	34.8 wks		5	$0.00
486	1.12	LGS PD concludes	Thu 5/28/20	Fri 5/29/20	0 wks	0.2 wks		178	$0.00
487	1.13	AOS Critical Design	Mon 6/1/20	Fri 1/29/21	0 wks	35 wks		8	$0.00
488	1.14	RTC design complete	Fri 6/19/20	Mon 6/22/20	0 wks	0.2 wks		437	$0.00
489	1.15	LGS CD concludes	Thu 1/28/21	Fri 1/29/21	0 wks	0.2 wks		209	$0.00
490	1.16	RTC -- GeMS RTC deployed	Fri 10/8/21	Mon 10/11/21	0 wks	0.2 wks		476	$0.00
491	1.17	AOS control computer ready for integration	Mon 1/17/22	Mon 1/17/22	0 wks	0.2 wks		417	$0.00
492	1.18	RTC -- GNAO RTC ready for integration	Fri 4/22/22	Mon 4/25/22	0 wks	0.2 wks		477	$0.00
493	1.19	LGS laser system 1 installed and commissioned	Fri 7/22/22	Fri 7/22/22	0 wks	0.2 wks		290	$0.00
494	1.20	AOS Build	Mon 2/1/21	Mon 10/3/22	0 wks	87.2 wks		11	$0.00
495	1.21	LGS laser system 2 installed and commissioned	Mon 10/24/22	Mon 10/24/22	0 wks	0.2 wks		301	$0.00
496	1.22	LGS control computer tested and ready	Tue 3/28/23	Tue 3/28/23	0 wks	0.2 wks		342	$0.00
497	1.23	AOS I&T	Tue 10/4/22	Fri 3/29/24	0 wks	77.8 wks		14	$0.00
498	1.24	First Light	Mon 4/1/24	Mon 4/1/24	0 wks	0.2 wks		497	$0.00