Cluster Charges

v4

Sections:

1. Summary

Research projects and programs have become increasingly dependent upon information-processing capabilities. Of these capabilities, UNC-Chapel Hill's computational clusters (administered by ITS-Research Computing) are some of the most substantial. In the procurement of the KillDevil cluster, there was an agreed intent to impose a charging structure. This document summarizes that charging structure, some of the challenges it presents, and provides recommendations for adjustments and final approval/implementation.

To keep proper focus, we address *only* computational clusters in this document; ITS-Research Computing's other services, staff, consultations, and engagement in support of the UNC-Chapel Hill research community are set aside for separate consideration.

The intent of the computational resource charging structure was threefold: (i) to establish a structure so costs can be defrayed via direct budget lines in grant/contract proposals; (ii) to motivate considered/wise use of the computational resource; (iii) to foster a community of stakeholders (viz., so that high-end users have “skin in the game”).

The initial structure to realize these intents included an institutional allocation of 200,000 core hours per lead investigator at no charge. Hours in excess of 200,000 are to be charged at a half-cent per core hour ($.005/hour). ITS-Research Computing provided “dry run” usage reports from February 2013 through June 2013, with the stated intent that consumption accrued starting July 1, 2013 would be *eligible* for charge under this structure. ITS-Research Computing has provided monthly usage reports since February 2013.

In October and November of 2013, ITS-Research Computing staff interviewed lead investigators whose utilization exceeded 200,000 core hours. As a result of these interviews, and also because of our own internal analyses, we propose the following adjustments:

1. Charges less than $1000/year will not be collected;

2. Add an allocation/exception process: e.g., to address educational use, to address appropriate uses for which no funding is available, etc.

3. Use the allocation/exception process to accomplish implementation phase-in.

For fiscal year 2013-2014, we propose to waive eligible charges. This allows researchers to continue phasing appropriate language in upcoming grant proposals. It also allows for notice and implementation of an appropriate exception process. Finally, it provides for a uniform implementation.

2. KillDevil cost analysis (annualized)

Excluding facilities costs (power, cooling, raised-floor, building, etc.) the KillDevil total cost of ownership, assuming a 4-year lifecycle, is as depicted below:

Component		Cost (4-year)
Hardware:[1]		
	KillDevil Initial (8400 cores; Lustre scratch; Infiniband)	5,552,000
	Additional Cores (1088)	450,000
	Net-Scratch	475,000
	Arista 10Gbps Dedicated	750,000
Personnel:		
	Cluster Administration (2 FTE)	800,000
	Storage Administration (.5 FTE)	200,000
	4-year TOTAL:	**$8,227,000**
	ANNUALIZED:	**$2,056,750**

Thus, a four (4) year total cost of ownership, excluding facilities costs, is $8.2m. That constitutes an annual spend of roughly $2m. This also excludes the cost of personnel and services to manage/conduct accounting and chargeback activities; finally, it excludes software costs and the costs associated with the ITS-Research Computing engagement team who assist investigators and their staff in utilizing the computational resource well.

Knowing the maximum number of core-hours is a fuzzier matter. If we simply assume 9500 cores, by 24 hours of runtime per core, and 365 days of runtime per year, we have a maximum possible of 83,220,000 core hours. On this analysis, the annual *actual cost* per core-hour is $0.025 (or two-and-a-half cents per core-hour). If we assume the same, but with five days of downtime for maintenance and emergency activity, we have a maximum of 82,080,000 core hours. On this, the annual *actual cost* is also $0.025 per core hour. If we consider the *consumable* core-hours, matters become fuzzy. Different job characteristics take more/less time to dispatch—and one of the principal

1 Note that these hardware charges represent a mix of lease and capital purchases. For formal purposes with the final Cost Analysis documentation with the Office of Sponsored Research, capital purchases will represent the cost of hardware as depreciation, not as cost to purchase.

factors is the time it takes for the scheduler to collect adequate resources. E.g., a 1024-way job demands that the scheduler find sufficient cores; and this takes time to gather, particularly on a busy system. With backfill working properly, some of this time can be reclaimed for smaller jobs. In other words, the *consumable* core hours depends not just on the total number of cores in the cluster, but also on the scheduler, how scheduling is configured, but even more so on the nature of the jobs/workload submitted.

For simplicity's sake let us suppose that, taking into account maintenance, emergency activity, and the overhead of job scheduling, it is possible to achieve ninety percent (90%) of the maximum possible hours. On this supposition, we have a maximum of 74,898,000 core hours. On this analysis, the annual *actual cost* per core-hour is $0.028.

Analysis of scheduler statistics over the past eighteen (18) months when we have no "idle" cores indicates that the maximum consumable hours is closer to sixty-six (66) million per year. However, since a smaller value for annual core hours serves to increase the cost analysis, and ITS-Research Computing continues to improve scheduling efficiencies (e.g., by fixing the "backfill" bug), we propose to settle on the 90% figure.

Thus, for the purposes of this analysis and charges structure recommendation, we stipulate that **we have a maximum of 74,898,000 core hours. On this analysis, the annual *actual cost to UNC-Chapel Hill* per core-hour is $0.028**.

To put this in perspective, let us consider the *actual cost to UNC-Chapel Hill* for the top-fifteen KillDevil groups in fiscal year 2012-2013, anonymized. See Table 1.

TABLE 1 – FY2012-2013

Group Rank	12 Months Core Hours	% of All Consumed Hours	Actual Cost to UNC-CH (@ $.028/hr)
1	6065500	10.14%	$169,834.01
2	4073834	6.81%	$114,067.35
3	4073391	6.81%	$114,054.96
4	3788170	6.33%	$106,068.77
5	3614866	6.04%	$101,216.26
6	2975539	4.97%	$83,315.09
7	2308122	3.86%	$64,627.42
8	2055235	3.44%	$57,546.57
9	1874136	3.13%	$52,475.81
10	1723393	2.88%	$48,254.99
11	1557155	2.60%	$43,600.33
12	1301252	2.18%	$36,435.05
13	1253948	2.10%	$35,110.55
14	1151605	1.93%	$32,244.93
15	1125001	1.88%	$31,500.04
TOP-15 TOTALS:	38941147	65.11%	$1,090,352.12

Considering the first six (6) months of fiscal year 2013-2014, and taking the gross estimate of a full year at two times that, the present fiscal year *actual cost* for the top-fifteen groups is in Table 2.

TABLE 2 – FY2013-2014

Group Rank	(6-Months * 2) Core Hours	% of All Consumed Hours	Actual Cost to UNC-CH (@ $.028/hr)
1	7621411	13.97%	$213,399.52
2	6753410	12.38%	$189,095.49
3	3066964	5.62%	$85,874.99
4	2611839	4.79%	$73,131.50
5	2592545	4.75%	$72,591.26
6	2228979	4.09%	$62,411.41
7	1993802	3.66%	$55,826.44
8	1662664	3.05%	$46,554.59
9	1498698	2.75%	$41,963.54
10	1493071	2.74%	$41,805.99
11	1355506	2.49%	$37,954.18
12	1280525	2.35%	$35,854.69
13	1187985	2.18%	$33,263.58
14	910586	1.67%	$25,496.40
15	866480	1.59%	$24,261.45
TOP-15 TOTALS:	37124465	68.07%	$1,039,485.03

It is worth noting that metering the analysis to a 4-year cycle is flawed in that the cluster hardware will itself likely have a 5-year duty cycle. If we do that, then the annualized cost is $1.9m, which would yield an actual annual cost per core hour of $0.025. While these partial cents matter, we propose to retain the 4-year analysis.

3. As-is Charges

A brief review of the *current* charging structure is in order.

Table 3 below depicts the as-is model as it would have been applied in fiscal year 2012-2013. The blue column the *as-is charges* for a PI-group at $0.005 per core hour (a half cent per core hour). The last column shows the total institutional investment, assuming the as-is scheme. We also indicate the group beyond which no charges apply, and totals.

TABLE 3 – FY2012-2013

Group Rank	12 Months Core Hours	% of All Consumed Hours	Actual Cost to UNC-CH (@ $.028/hr)	As-is Charge to Pis (@ $.005/hr)	As-is UNC-CH Institutional Investment
1	6065500	10.14%	$169,834.01	$29,327.50	$140,506.51
2	4073834	6.81%	$114,067.35	$19,369.17	$94,698.18
3	4073391	6.81%	$114,054.96	$19,366.96	$94,688.00
4	3788170	6.33%	$106,068.77	$17,940.85	$88,127.92
5	3614866	6.04%	$101,216.26	$17,074.33	$84,141.93
6	2975539	4.97%	$83,315.09	$13,877.69	$69,437.39
7	2308122	3.86%	$64,627.42	$10,540.61	$54,086.81
8	2055235	3.44%	$57,546.57	$9,276.17	$48,270.40
9	1874136	3.13%	$52,475.81	$8,370.68	$44,105.13
10	1723393	2.88%	$48,254.99	$7,616.96	$40,638.03
11	1557155	2.60%	$43,600.33	$6,785.77	$36,814.55
12	1301252	2.18%	$36,435.05	$5,506.26	$30,928.79
13	1253948	2.10%	$35,110.55	$5,269.74	$29,840.81
14	1151605	1.93%	$32,244.93	$4,758.02	$27,486.91
15	1125001	1.88%	$31,500.04	$4,625.01	$26,875.03
16	973729	1.63%	$27,264.40	$3,868.64	$23,395.76
17	950986	1.59%	$26,627.61	$3,754.93	$22,872.68
18	927986	1.55%	$25,983.61	$3,639.93	$22,343.68
19	913495	1.53%	$25,577.86	$3,567.47	$22,010.38
20	902459	1.51%	$25,268.86	$3,512.30	$21,756.56
21	857616	1.43%	$24,013.25	$3,288.08	$20,725.17
22	820461	1.37%	$22,972.92	$3,102.31	$19,870.61
23	800640	1.34%	$22,417.92	$3,003.20	$19,414.72
24	787771	1.32%	$22,057.59	$2,938.85	$19,118.73
25	773990	1.29%	$21,671.73	$2,869.95	$18,801.77
26	694640	1.16%	$19,449.91	$2,473.20	$16,976.71
27	668715	1.12%	$18,724.03	$2,343.58	$16,380.45
28	462701	0.77%	$12,955.62	$1,313.50	$11,642.12
29	458345	0.77%	$12,833.65	$1,291.72	$11,541.93
30	454565	0.76%	$12,727.82	$1,272.83	$11,455.00
31	437999	0.73%	$12,263.98	$1,190.00	$11,073.99
32	433586	0.72%	$12,140.42	$1,167.93	$10,972.49
33	410635	0.69%	$11,497.78	$1,053.17	$10,444.60
TOP-33 TOTALS:	51671467	86.39%	$1,446,801.08	$225,357.34	$1,221,443.74
…	…		…	…	…
255	0	0.00%	$0.00	$0.00	$0.00
TOTALS:	59810777	100.00%	$1,674,701.75	$231,625.49	$1,443,076.26

Similar information for fiscal year 2013-2014, extrapolated as before, is in Table 4.

TABLE 4 – FY2013-2014

Group Rank	(6-Months * 2) Core Hours	% of All Consumed Hours	Actual Cost to UNC-CH (@ $.028/hr)	As-is Charge to Pis (@ $.005/hr)	As-is UNC-CH Institutional Investment
1	7621411	13.97%	$213,399.52	$37,107.06	$176,292.46
2	6753410	12.38%	$189,095.49	$32,767.05	$156,328.44
3	3066964	5.62%	$85,874.99	$14,334.82	$71,540.17
4	2611839	4.79%	$73,131.50	$12,059.20	$61,072.30
5	2592545	4.75%	$72,591.26	$11,962.73	$60,628.54
6	2228979	4.09%	$62,411.41	$10,144.89	$52,266.52
7	1993802	3.66%	$55,826.44	$8,969.01	$46,857.43
8	1662664	3.05%	$46,554.59	$7,313.32	$39,241.27
9	1498698	2.75%	$41,963.54	$6,493.49	$35,470.05
10	1493071	2.74%	$41,805.99	$6,465.35	$35,340.63
11	1355506	2.49%	$37,954.18	$5,777.53	$32,176.65
12	1280525	2.35%	$35,854.69	$5,402.62	$30,452.07
13	1187985	2.18%	$33,263.58	$4,939.93	$28,323.66
14	910586	1.67%	$25,496.40	$3,552.93	$21,943.47
15	866480	1.59%	$24,261.45	$3,332.40	$20,929.05
16	864174	1.58%	$24,196.86	$3,320.87	$20,875.99
17	786141	1.44%	$22,011.94	$2,930.70	$19,081.24
18	754394	1.38%	$21,123.03	$2,771.97	$18,351.06
19	689085	1.26%	$19,294.37	$2,445.42	$16,848.94
20	629157	1.15%	$17,616.41	$2,145.79	$15,470.62
21	627359	1.15%	$17,566.07	$2,136.80	$15,429.27
22	615220	1.13%	$17,226.16	$2,076.10	$15,150.06
23	552452	1.01%	$15,468.65	$1,762.26	$13,706.39
24	545373	1.00%	$15,270.45	$1,726.87	$13,543.59
25	535718	0.98%	$15,000.09	$1,678.59	$13,321.50
26	494789	0.91%	$13,854.10	$1,473.95	$12,380.15
27	475634	0.87%	$13,317.74	$1,378.17	$11,939.57
28	473883	0.87%	$13,268.72	$1,369.41	$11,899.30
29	417250	0.77%	$11,683.01	$1,086.25	$10,596.76
TOP-29 TOTALS:	45585094	83.58%	$1,276,382.63	$198,925.47	$1,077,457.16
…	…	…	…	…	…
231	0	0.00%	$0.00	$0.00	$0.00
TOTALS:	54538101	100.00%	$1,527,066.84	$205,632.58	$1,321,434.26

For fiscal year 2012-2013, groups charges, were they applied and fully recovered, would have accounted for 16% of the annual cost; so the institution would have borne 84% of the annual cost. In fiscal year 2013-2014, assuming the gross extrapolation, 15.56% of the annual cost to operate would be borne by group charges: if all charges were applied and collected, the institutional investment would come to 84.44% of the annual cost.

Whether the level of institutional investment (and thus charges structure) is appropriate is perhaps a

matter for Goldilocks to adjudicate. Indeed, unlike the real Goldilocks, who had only to worry over the temperature of porridge, in this case, there are four related concerns that fall into a "*Too-little? Too-much? Just-right.*" decision procedure:

1. ***Revenue target***: the more revenue to be collected, either the allocation or pricing (or both) should be modified: e.g., more usage would be eligible for charges if the university lowered the allocation; or, of the usage that is eligible for charges, the charges would be greater if the university increased the pricing. Alternatively, for less revenue, the allocation should be increased or the pricing decreased (or both). There are two factors that influence the revenues generated. The revenue target is not independently specified, so it is not independently clear how much revenue is too-little, too-much, just-right. The intent of the revenue target is partially to fund computational cluster purchases, thus offsetting additional costs for growth, or allow for reallocation of some institutional funds to other services and initiatives.
2. ***Institutional allocation***: as the allocation increases, the count of core-hours subject to charge decreases, which in turn influences revenues—obviously, core hours not subject to charge cannot generate revenue. There are two general intents for the allocation. The first is to provide researchers a capability to *build* research projects without a barrier to entry. A complication here is that different disciplines and problems within disciplines can have enormously different numerical methods, some of which are vastly more computationally intensive than others. The second is to right-size administrative/overhead costs—the goal here is to set the allocation at a threshold where the additional administrative costs of managing the data collection, reporting, billing and, accounting, are materially overcome by the charges actually collected.
3. ***Over-allocation pricing***: the principal challenge here is how much additional cost a lead investigator can bear. For example, if an investigator consumes his/her allocation and consumes $30,000/year of over-allocation core-charges for a 3-year project, that amounts to a burden of $90,000 on the life of the project for what comes to be an equipment cost. While the institutional investment makes this a bargain for the investigator, this kind of burden may effectively end the research project. This might be appropriate, or not. The issue at hand, however, is that whatever the pricing is, it will impact whether projects will continue or cease. Similarly, this will impact faculty recruitment. The issue is perhaps not *whether* there should be a threshold, but rather *what* that threshold should be: the threshold will be a gross "tool" by which to sift computational research projects into those that meet their demise, those that survive, and those that flourish. Thus, this pricing has the same too-little, too-much, just-right, character.
4. ***Impact on competitiveness***: this pertains mostly to proposals that are expected to involve over-allocation core-hour consumption. As the over-allocation burden increases, it adds cost to the proposal. Various agencies differ in their approaches. Presumably, however, there is a threshold—which may vary by agency—additional charges significantly undermine the likelihood of successful proposals. Or, an agency may fund only a *portion* of the proposed budget and leave accomplishing the objectives to the investigator, thus making the investigator make choices between post-doc staffing to conduct the work, or adequate computational resource on which to execute the work. In either case, beyond some level, the risk of satisfying the project objectives/deliverables may reach a point where the responsible

investigator or institution should reject the award. It is not obvious what this threshold is, and it likely varies by agency: how much is too much is again a question for Goldilocks, but in this case a Goldilocks per agency.

Since the principal intentions are not revenue-oriented—viz., there is no revenue target—the upshot is to use a charging scheme as an indirect tool by which to accomplish those intents. Thus, the revenue target should follow from other objectives; revenue-generation is a result of the tool by which we attempt to achieve the institution's goals.

Each of these concerns is germane. Some are relevant moreso to investigators than administrators; some moreso to the institution than individuals. The principal points we would like to glean from this cursory review are that (i) it is difficult to optimize for *any* Goldilocks problem, and (ii) there are at least four in this case. There is no theory nor set of axioms that will decide these. It is a matter of judgment and taste.

With these considerations in tow, we suggest that our overarching aim should be to make measurable progress on the intent/objectives of the charging structure, yet also make every effort to minimize disruption to the computational research at UNC-Chapel Hill.

4. Proposed: Minimum Charges Collection Trigger

PLEASE NOTE: for fiscal year 2013-2014, we propose to waive charges. Thus, this is for analytical purposes in the present fiscal year.

We propose to institute a minimum charge of $1,000 below which we will not collect. This is to minimize administrative burden, and also to foster the growth of computational research at UNC-Chapel Hill. In effect, this increases the institutional allocation.

Let us first review the impact of these proposed changes. See Table 5, below, characterizing what would have occurred in fiscal year 2012-2013. The blue column is the charges on the proposed model.

TABLE 5 – FY2012-2013

Group Rank	12 Months Core Hours	% of All Consumed Hours	Actual Cost to UNC-CH (@ $.028/hr)	As-is Charge to Pis (@ $.005/hr)	As-is UNC-CH Institutional Investment	Min-Model Charges to Pis	Min-Model UNC-CH Institutional Investment
1	6065500	10.14%	$169,834.01	$29,327.50	$140,506.51	$29,327.50	$140,506.51
2	4073834	6.81%	$114,067.35	$19,369.17	$94,698.18	$19,369.17	$94,698.18
3	4073391	6.81%	$114,054.96	$19,366.96	$94,688.00	$19,366.96	$94,688.00
4	3788170	6.33%	$106,068.77	$17,940.85	$88,127.92	$17,940.85	$88,127.92
5	3614866	6.04%	$101,216.26	$17,074.33	$84,141.93	$17,074.33	$84,141.93
6	2975539	4.97%	$83,315.09	$13,877.69	$69,437.39	$13,877.69	$69,437.39
7	2308122	3.86%	$64,627.42	$10,540.61	$54,086.81	$10,540.61	$54,086.81
8	2055235	3.44%	$57,546.57	$9,276.17	$48,270.40	$9,276.17	$48,270.40
9	1874136	3.13%	$52,475.81	$8,370.68	$44,105.13	$8,370.68	$44,105.13
10	1723393	2.88%	$48,254.99	$7,616.96	$40,638.03	$7,616.96	$40,638.03
11	1557155	2.60%	$43,600.33	$6,785.77	$36,814.55	$6,785.77	$36,814.55
12	1301252	2.18%	$36,435.05	$5,506.26	$30,928.79	$5,506.26	$30,928.79
13	1253948	2.10%	$35,110.55	$5,269.74	$29,840.81	$5,269.74	$29,840.81
14	1151605	1.93%	$32,244.93	$4,758.02	$27,486.91	$4,758.02	$27,486.91
15	1125001	1.88%	$31,500.04	$4,625.01	$26,875.03	$4,625.01	$26,875.03
16	973729	1.63%	$27,264.40	$3,868.64	$23,395.76	$3,868.64	$23,395.76
17	950986	1.59%	$26,627.61	$3,754.93	$22,872.68	$3,754.93	$22,872.68
18	927986	1.55%	$25,983.61	$3,639.93	$22,343.68	$3,639.93	$22,343.68
19	913495	1.53%	$25,577.86	$3,567.47	$22,010.38	$3,567.47	$22,010.38
20	902459	1.51%	$25,268.86	$3,512.30	$21,756.56	$3,512.30	$21,756.56
21	857616	1.43%	$24,013.25	$3,288.08	$20,725.17	$3,288.08	$20,725.17
22	820461	1.37%	$22,972.92	$3,102.31	$19,870.61	$3,102.31	$19,870.61
23	800640	1.34%	$22,417.92	$3,003.20	$19,414.72	$3,003.20	$19,414.72
24	787771	1.32%	$22,057.59	$2,938.85	$19,118.73	$2,938.85	$19,118.73
25	773990	1.29%	$21,671.73	$2,869.95	$18,801.77	$2,869.95	$18,801.77
26	694640	1.16%	$19,449.91	$2,473.20	$16,976.71	$2,473.20	$16,976.71
27	668715	1.12%	$18,724.03	$2,343.58	$16,380.45	$2,343.58	$16,380.45
28	462701	0.77%	$12,955.62	$1,313.50	$11,642.12	$1,313.50	$11,642.12
29	458345	0.77%	$12,833.65	$1,291.72	$11,541.93	$1,291.72	$11,541.93
30	454565	0.76%	$12,727.82	$1,272.83	$11,455.00	$1,272.83	$11,455.00
31	437999	0.73%	$12,263.98	$1,190.00	$11,073.99	$1,190.00	$11,073.99
32	433586	0.72%	$12,140.42	$1,167.93	$10,972.49	$1,167.93	$10,972.49
33	410635	0.69%	$11,497.78	$1,053.17	$10,444.60	$1,053.17	$10,444.60
TOP-33 TOTALS:	51671467	86.39%	$1,446,801.08	$225,357.34	$1,221,443.74	$225,357.34	$1,221,443.74
…	…		…	…	…	…	…
255	0	0.00%	$0.00	$0.00	$0.00	$0.00	$0.00
TOTALS:	59810777	100.00%	$1,674,701.75	$231,625.49	$1,443,076.26	$225,357.34	$1,449,344.42

And for fiscal year 2013-2014, the proposed structure would be as show in Table 6.

TABLE 6 – FY2013-2014

Group Rank	(6-Months * 2) Core Hours	% of All Consumed Hours	Actual Cost to UNC-CH (@ $.028/hr)	As-is Charge to Pis (@ $.005/hr)	As-is UNC-CH Institutional Investment	Min-Model Charges to Pis	Min-Model UNC-CH Institutional Investment
1	7621411	13.97%	$213,399.52	$37,107.06	$176,292.46	$37,107.06	$176,292.46
2	6753410	12.38%	$189,095.49	$32,767.05	$156,328.44	$32,767.05	$156,328.44
3	3066964	5.62%	$85,874.99	$14,334.82	$71,540.17	$14,334.82	$71,540.17
4	2611839	4.79%	$73,131.50	$12,059.20	$61,072.30	$12,059.20	$61,072.30
5	2592545	4.75%	$72,591.26	$11,962.73	$60,628.54	$11,962.73	$60,628.54
6	2228979	4.09%	$62,411.41	$10,144.89	$52,266.52	$10,144.89	$52,266.52
7	1993802	3.66%	$55,826.44	$8,969.01	$46,857.43	$8,969.01	$46,857.43
8	1662664	3.05%	$46,554.59	$7,313.32	$39,241.27	$7,313.32	$39,241.27
9	1498698	2.75%	$41,963.54	$6,493.49	$35,470.05	$6,493.49	$35,470.05
10	1493071	2.74%	$41,805.99	$6,465.35	$35,340.63	$6,465.35	$35,340.63
11	1355506	2.49%	$37,954.18	$5,777.53	$32,176.65	$5,777.53	$32,176.65
12	1280525	2.35%	$35,854.69	$5,402.62	$30,452.07	$5,402.62	$30,452.07
13	1187985	2.18%	$33,263.58	$4,939.93	$28,323.66	$4,939.93	$28,323.66
14	910586	1.67%	$25,496.40	$3,552.93	$21,943.47	$3,552.93	$21,943.47
15	866480	1.59%	$24,261.45	$3,332.40	$20,929.05	$3,332.40	$20,929.05
16	864174	1.58%	$24,196.86	$3,320.87	$20,875.99	$3,320.87	$20,875.99
17	786141	1.44%	$22,011.94	$2,930.70	$19,081.24	$2,930.70	$19,081.24
18	754394	1.38%	$21,123.03	$2,771.97	$18,351.06	$2,771.97	$18,351.06
19	689085	1.26%	$19,294.37	$2,445.42	$16,848.94	$2,445.42	$16,848.94
20	629157	1.15%	$17,616.41	$2,145.79	$15,470.62	$2,145.79	$15,470.62
21	627359	1.15%	$17,566.07	$2,136.80	$15,429.27	$2,136.80	$15,429.27
22	615220	1.13%	$17,226.16	$2,076.10	$15,150.06	$2,076.10	$15,150.06
23	552452	1.01%	$15,468.65	$1,762.26	$13,706.39	$1,762.26	$13,706.39
24	545373	1.00%	$15,270.45	$1,726.87	$13,543.59	$1,726.87	$13,543.59
25	535718	0.98%	$15,000.09	$1,678.59	$13,321.50	$1,678.59	$13,321.50
26	494789	0.91%	$13,854.10	$1,473.95	$12,380.15	$1,473.95	$12,380.15
27	475634	0.87%	$13,317.74	$1,378.17	$11,939.57	$1,378.17	$11,939.57
28	473883	0.87%	$13,268.72	$1,369.41	$11,899.30	$1,369.41	$11,899.30
29	417250	0.77%	$11,683.01	$1,086.25	$10,596.76	$1,086.25	$10,596.76
TOP-29 TOTALS:	45585094	83.58%	$1,276,382.63	$198,925.47	$1,077,457.16	$198,925.47	$1,077,457.16
…	…	…	…	…	…	…	…
231	0	0.00%	$0.00	$0.00	$0.00	$0.00	$0.00
TOTALS:	54538101	100.00%	$1,527,066.84	$205,632.58	$1,321,434.26	$198,925.47	$1,328,141.37

It is plain that this approach is an attempt to navigate between the various Goldilocks concerns listed in the previous section with a deliberately non-punitive start at what might be "just right" for each.

We suggest that this approach is a reasonable start to satisfying the stated intent of the charges structure. With this considered approach, over some couple years, realizable revenues will become more clear, which will inform possible adjustments to the relevant thresholds. Further, as year-over-year charges come in, and as feedback emerges with respect to impact on research

programs and success in grant competitions, the university can choose to specify revenue targets, *or* different thresholds for the other desiderata.

Our current overriding concern is not to induce a meteoric burden on any one project/program. Our purpose is to foster research programs that make fair and judicious use of resources.

This structure will be reviewed annually by the Research Computing Advisory Committee and the Research Computing Coordinating Committee to make appropriate adjustments as further information and evidence accumulate. It also is subject to the guidelines and requirements of the Office of Sponsored Research Cost Analysis unit.

5. Exception process

UNC-Chapel Hill recognizes that computational research varies with respect to its data and processing demands, and also with respect to the need to compute, modify theories/codes, re-compute, etc.. UNC-Chapel Hill is also committed to providing a base computational resource both to help build research programs and to extend the value of extramural contracts/grants/awards. The university acknowledges, too, that the likelihood of solution and time to solution varies by scientific discipline/method and by the specific research objectives of particular projects: while some projects may take weeks to realize, some may take decades to realize. Scientific problems are not one-sized; therefore, computational demands are not one-sized. Further, some projects are undertaken in the context of education, some in partnership with external groups/collaborators, some for federal agencies, etc..

Thus, it is necessary to include an exception process for KillDevil charges. An investigator who has insufficient funds to cover his/her over-allocation expenses may apply for an exception, and in so doing will attest:

1. The over-consumption core-hours are unrelated to any/all extramurally funded projects; and
2. His/her organizational unit has insufficient resources to fund the charges; and
3. He/she requests a central institutional source to fund his/her over-allocation charges.

Investigators may provide partial funding from extramural or organizational resources and request exception for the balance. In effect, this is a request for an *after the fact* institutional grant of an additional core-hour allocation. ITS-Research Computing will provide a standard form for the exception request.

Authorities are as follows. The Assistant Vice Chancellor for Research Computing will be authorized to approve a one-year exception. The AVC of Research Computing will report on grantees to the Research Computing Advisory Committee for each grantee's first year. Any grantee who requests a second-year grant will be subject to the vote of the membership of the Research Computing Advisory Committee (majority approves). A grantee who requests a third-year grant will be subject to the vote of the membership of the Research Computing Coordinating Committee. Any exception requests beyond a third-year will be subject to the determination of Research Computing

Coordinating Committee.

This approach provides flexibility, yet ensures university oversight from formally sanctioned governance committees. It also assumes and guarantees compliance with guidelines and requirements of the Office of Sponsored Research Cost Analysis.

6. Conclusion

We have outlined proposed revisions to the as-is charging structure. We propose to implement it as follows:

1. Review analysis and document with all charge-eligible investigators in fiscal year 2013-2014; this is a follow-up from our October/November 2013 interviews. Solicit “buy-in”.
2. Notify charge-eligible investigators that charges are waived for FY2013-2014; but will not be waived for FY2014-2015.
3. Provide all investigators approved/new charge structure, including exception process, to be made effective on July 1, 2014. Investigators who do not have access to sufficient funding resources will be required to follow the exception process, as outlined.
4. Report semi-annually to Research Computing Advisory Committee, and Research Computing Coordinating Committee, and also all lead investigators on ITS-Research Computing computational clusters, the actual cost, passed-on charges, and exception cost, for that term.

Subsequent cluster replacements will be phased-in on the same model. For example, when the Kure cluster is replaced, unless a different model is explicitly it will follow the same model as that which is here proposed.

Please note that this document addresses *only* the most direct segments of the charging and funding scheme for the KillDevil cluster (which we stipulate would extend to Kure's replacement). There are many other services, projects, and staff, in ITS-Research Computing who participate in myriad internal, external, systems management, consultation, and engagement activities. So, while the computational cluster service is undoubtedly one of our most important (core) services, it is important not to assume that this summary document has characterized the full scope of ITS-Research Computing's activities and support of the UNC-Chapel Hill research community.